13793

Section III

Proposed Remedy for Asbestos Waste Sites

Technical Appendices to Proposed Consent Decrees

2. Expert Reports
   - A. Quality and Type of Earth Cover
     1. Jerry Kranse, Soil Conservation Service
   - B. Quality and Depth of Earth Cover
     1. Alex Iskandar, U.S. Army Corps of Engineers
     2. Richard McGew, U.S. Army Corps of Engineers

These materials cover the Materazzo, Bursey, Baker and Alukonis sites. Except for perhaps minor changes, they apply equally to the Columbe and Sprague sites.

IN THE UNITED STATES DISTRICT COURT

FOR THE DISTRICT OF NEW HAMPSHIRE

UNITED STATES OF AMERICA, Plaintiff, v. JOHNS-MANVILLE SALES CORPORATION; ANTHONY MATARAZZO; ARTHUR BURSEY, JR.; THOMAS BAKER: STANLEY ALUKONIS; JAMES CHOATE; and JOSEPH LEMIEUX Defendants.	)	Civil Action No. 81-299-D

APPENDIX B FOR

THE THOMAS BAKER PROPERTY

1.0 General

The work to be completed under this appendix includes the obtaining of all necessary permits and furnishing all tools, equipment, labor, and materials necessary to complete the closure of this inactive disposal site as specifically outlined under "Scope of Work" below. Without prejudice to the foregoing, the quality of construction shall be as stipulated in these specifications and all work done shall be the responsibility of Johns-Manville. EPA and the State require materials and workmanship equal to present good industrial construction. The specifications should be read in conjunction Drawing No. 100110-2, "Area Plan of Inactive Disposal Sites," and with Drawing No. 100112-2, "Plot Plan".

2.0 Scope of Work

2.1 The complete shaping and grading of banks and disposal sites, providing acceptable cover material and necessary slope protection, fertilizing cover material, and seeding the following disposal site. See Drawing No. 100110-2.

2.1.1 Thomas Baker property on N.H. Route 111.

2.2 The scope of work for this site includes the following:

2.2.1 Clean the site and remove debris as required. See paragraphs 6, 10, 13, and 14.

2.2.2 Clean up the west bank of asbestos waste material and remove same to the Bursey site for proper disposal as specified in Drawing No. 100112-2.

2.2.3 Shape and grade site to original grade as as specified on Drawing No. 100112-2.

2.2.4 Provide cover and vegetation as specified in paragraph 15 and 16.

3.0 Work Schedule

3.1 Johns-Manville shall start actual field activities included under this appendix by June 1, 1982.

3.2 Johns-Manville shall complete the mulching required by paragraph 16 of this appendix by October 29, 1982.

3.3 Johns-Manville shall prepare within thirty days after entry of this consent decree a construction schedule incorporating dates shown above for approval by EPA and State.

4.0 Special Inspections and Tests

Johns-Manville shall perform all tests and inspections during the construction phase that may be required by EPA and the State.

5.0 Safety Protection

Johns-Manville shall adhere strictly to all local, state, and federal Occupational Safety and Health Administration rules and regulations for industrial construction.

6.0 Cleanup

Johns-Manville shall maintain the work area in a clean and satisfactory manner and not allow asbestos-free debris to accumulate. A cleanup shall be made at least once a week or as directed by Johns-Manville. No dumping or burning of asbestos-free debris will be allowed on any of the private properties.

7.0 Codes and Ordinances

All construction shall comply strictly with all local, state and federal codes and/or ordinances where such are applicable. It shall be Johns-Manville's duty and responsibility to obtain the required approvals and all necessary permits.

8.0 Standards

References made to trade, technical, governmental or other codes, standards or specifications shall be interpreted as minimums and not maximums.

9.0 Field Measurements

Johns-Manville shall be responsible for the taking of all field measurements and the checking for any interferences before starting construction.

10.0 Asbestos Containing Materials

10.1 Johns-Manville shall note that the vast majority of the materials on the disposal site to be removed and relocated, shaped and graded, etc., are waste materials containing asbestos.

10.2 Johns-Manville shall comply with all Occupational Safety and Health Administration (OSHA), Environmental Protection Agency (EPA), and all state and local regulations for the safe handling of asbestos-containing materials. The excavation and fill areas of this site shall be adequately sprayed with water to prevent visible airborne emissions according to OSHA, EPA, state, and local regulations. Johns-Manville shall insure that appropriate safety equipment is used in accordance with OSHA regulations.

10.3 If any reason a work stoppage, extended weekend break, hot weather accompanied by dry high velocity winds, etc. should result in a condition where the exposed surfaces of the excavation and fill areas of asbestos-containing materials could result in possible visible airborne emissions, Johns-Manville shall take whatever measures are necessary to prevent visible airborne emissions from these temporarily exposed surfaces.

10.4 All equipment used in the closing of the disposal site shall be washed of all asbestos material prior to removal from the site.

11.0 Access to Private Propery

All access points shall be adequately maintained during the construction phase.

12.0 Temporary Security

Johns-Manville shall provide sufficient temporary security upon initiating actual field activities, as approved by EPA and the State, to discourage public access to the site until such time that the vegetation is established. This may include temporary fencing and/or signs or barriers.

13.0 Site Clearing and Grading of Materials Existing on the Site

13.1 Johns-Manville shall clear the site of brush and small trees. Johns-Manville shall minimize the amount of grubbing required as the larger trees will not be removed. All asbestos-free debris from this operation shall be removed from the property. Stumps and all other asbestos containing material shall be disposed of on site.

13.2 In shaping and grading on the site, some difficulty may result in relocating the waste material containing asbestos. Even though this material is unreinforced and by no means homogeneous, having been applied in varying layers over a long period of time, some breakage may be required before moving with a dragline, clamshell bucket, or front end loader. Johns-Manville shall minimize the amount of breakage required before moving the waste material with a dragline, clamshell bucket, or front end loader.

13.3 Johns-Manville shall shape and grade the site, including the east banks on the site, to grades as shown on Drawing No. 100112-2. It is not the intention of this plan and specifications to balance the cut and fill on this site. Fill material may be required in addition to the material needed to cover this inactive disposal site. Additional fill material, if needed, will be provided by Johns-Manville.

13.4 Slopes should not be steeper than one vertical to three horizontal on all shaping and grading operations.

13.5 Johns-Manville shall be aware that this is an asbestos waste disposal site and that the Environmental Protectio Agency requires the following precautions:

13.5.1 All necessary measures shall be employed during all phases of the project and especially during the shaping and grading of the major banks and the overall site to prevent visible emissions to the outside air from the job site and avoid emissions of asbestos particles from becoming airborne.

13.5.2 All exposed waste material on the site subject to traffic and removal by shaping and grading shall be adequately wetted during the project to prevent visible airborne emissions.

13.5.3 All waste material of the site that has been removed or displaced during shaping and grading should be adequately wetted to ensure that the material remains wet during all remaining stages of the project and related handling operations.

14.0 Work Outside Present Disposal Site

Miscellaneous piles of waste material found on the property outside of the present disposal area shall be cleaned up. The asbestos waste material shall be deposited on the principal disposal area and graded prior to placement of specified cover material.

15.0 Minimum 15-Inch Earth Cover

After completion of the shaping and grading of the disposal site, Johns-Manville shall place sufficient asbestos-free material to form a cover of at least 15 inches total settled depth over the disposal site as shown on Drawing No. 100112-2. This earth cover shall be compatible for vigorous plant growth.

15.1 The bottom nine inches of cover shall be as follows:

15.1.1 Cover Quality

It shall consist of materials of which not more than 35 per cent, by weight, will pass the #200 sieve and not more than 50 per cent, by weight, will be retained on the #4 sieve. Peat, muck and material over six inches in size shall be excluded from this cover.

15.1.2 Applying Cover

Johns-Manville shall grade and shape the bottom nine inches of cover to a smooth surface with no local irregularities in excess of four inches. Slopes shall not be steeper than one vertical to three horizontal on all shaping and grading operations.

15.2 The top minimum six inches of cover shall be as follows:

15.2.1 Topsoil Quality

Topsoil shall be within the following textures: sandy loam, loam, or silt loam. The material shall be friable and free of tree roots, weeds, stones more than 1-1/2 inches in diameter or length, and of other debris. It shall have a pH value between 6.2 and 7.0. In the absence of a soil test, agricultural limestone shall be applied at the minimum rate of 2 tons per acre (100 lbs per 1,000 sq. ft.) and shall be applied prior to or at the time of seeding and incorporated into the soil.

15.2.2 Sources of Topsoil

Material for topsoiling shall be taken from the natural surface layers (A horizon) of soils known to be capable of producing good yields of cultivated crops or hay. Soil that has been treated with a herbicide shall not be used for topsoiling, if it is determined that the residual effects of the herbicide will be damaging to the new seeding. Topsoil may be stripped from and stockpiled at a site for later replacement. Stockpiled topsoil shall not be compacted. Areas from which topsoil has been removed shall be protected against erosion with permanent vegetative cover.

15.2.3 Applying Topsoil

Topsoil shall not be collected or spread while it is wet. Subsurfaces shall be scarified or otherwise tilled to facilitate bonding prior to spreading topsoil. Topsoil shall be uniformly spread to a minimum settled depth of six inches. Slopes shall not be steeper than one vertical to three horizontal on all shaping and grading operations. Topsoil shall be shaped and graded to prevent ponding of water on the surface of the cover.

16.0 Seeding of Earth Cover

16.1 Seedbed Preparation

16.1.1 Surface and seepage water shall be drained or diverted from the site.

16.1.2 Stones larger than 1-1/2 inches and trash that will interfere with seeding and future maintenance of the area shall be removed. Where feasible, the soil shall be tilled to a depth of about 4 inches to prepare a seedbed and mix fertilizer into the soil. The seedbed shall be left in a reasonably firm and smooth condition. The last tillage operation shall be performed across the slope where practical.

16.2 Establishing a Stand

16.2.1 Lime, in addition to that applied pursuant to paragraph 15.2.1, and fertilizer shall be applied prior to or at the time of seeding and incorporated into the soil. Kinds and amounts of lime and fertilizer shall be based on an evaluation of soil tests. In the absence of a soil test, the following minimum amounts shall be applied:

Agricultural limestone, 2 tons per acre or 100 lbs. per 1,000 sq. ft.

Nitrogen (N), 50 pounds per acre or 1.1 lbs. per 1,000 sq. ft.

Phosphate (P_2O_5), 100 lbs. per acre or 2.2 lbs. per 1,000 sq. ft.

Potash (K_2O), 100 lbs. per acre or 2.2 lbs. per 1,000 sq. ft.

(NOTE: This fertilizer is the equivalent of 500 lbs. per acre of 10-20-20 fertilizer or 1000 lbs. per acre of 5-10-10.)

16.2.2 Seed shall be spread uniformly by the method most appropriate for the site. Methods include broadcasting, drilling, and hydroseeding. Where broadcasting is used, cover seed with 1/4 inch of soil or less, by cultipacking or raking.

16.2.3 For all areas of the site, apply seed mixture as follows:

Mixture	Pounds per acre	Pounds per 1,000 sq. ft.
Tall fescue	20	.45
Creeping red fescue	20	.45
Birdsfoot trefoil	8	.20
	48	1.10

16.2.4 Birdsfoot trefoil shall be inoculated.

16.3 Mulch

16.3.1 Hay, straw, jute and fibrous mat or wood excelsior shall be applied immediately after seeding as follows

Mulch Material/Rates	Remarks
Hay or Straw 1-1/2 to 2 tons per acre 70 to 90 lbs. per 1,000 sq. ft.	Can be spread by hand or by machine. Must be dry and free of mold. Subject to blowing and slipping on steep slopes unless anchored.

Mulch Material/Rates	Remarks
Jute and Fibrous Mats	Used as a mulch especially in areas of concentrated flow. Must be carefully installed and anchored. Can be used for erosion control without other mulching materials. The waterway, channel, or area to be protected is to be shaped to required shape and grade and thoroughly compacted before seedbed preparation. Rocks or clods over 1-1/2 inches in diameter and sticks or other material that will prevent contact of the fiber matting with the soil surface should be removed. After seeding is completed, matting should be laid in the direction of flow and applied in accordance with instructions in each roll of material. After matting is installed, a cultipacker or other suitable implement should be rolled at right angles over the entire area so as to thoroughly fuse the matting with the soil surface.
Wood Excelsior	Apply according to manufacturer's recommendations.

16.3.2 Mulch shall be held in place using the following techniques:

Mulch Anchoring Materials	Rates/Remarks
Asphalt Emulsion	Use type SS-1, MS-2, RS-1, or RS-2 at 150 to 200 gals. per acre. May be blown on with hay or straw or sprayed on after spreading them. Special equipment is required to apply asphalt.

Mulch Nettings (Paper. twine, plastic or wood fiber)	Spread over loose mulch such as hay or straw and pin to the soil per manufacturer's instructions.
Pegs and Twine	Used mostly on small areas to anchor loose mulch materials. Set 8 to 10-inch wooden pegs on 3x3 foot spacings. Drive pegs within 3 inches of soil surface. Use twine to weave a net between pegs. Loop twine twice about each peg and pull firmly. After weaving twice, drive pegs flush with soil to tighten it and avoid interference with mowing.
Synthetic Emulsions	Binds fiber mulches. Follow manufacturer's application directions.
Punching into the Soil	Ends of fibers will be pushed into the soil approximately 3 inches by passing over them with a special implement built for the purpose, or a farm disc set straight, or by the use of a shovel in small areas.

ETHURA
A Research and Consulting Company

January 14, 1982

Ms. Deborah Dalton
Office of Hazardous Wastes Enforcement
U. S. Environmental Protection Agency
Washington, DC 20460

Dear Ms. Dalton;

Enclosed please find the work plan for the asbestos sites in Hudson, New Hampshire. This plan is what is needed to determine if the asbestos is actually moving up through the soil at the study sites. I have included other studies that should be of value to EPA and the State of New Hampshire in monitoring the consent decree. The costs that are included in Appendix D are based upon my estimates of what it would take to do each of the studies. There is considerable advantage to having the studies done concurrently. The overall increase in cost is about $3,000 per year but the gain is considerable. I estimate that with only the asbestos heaving studies that would be needed that it would cost EPA about $9,000 per year.

The proposed laboratory studies that are proposed for CRREL are not costed out. I could not determine what the costs for the laboratory would be but have given you some cost figures where they are available. I would recommend trying to negotiate with CRREL on some sort of a swap. You purchase the extra equipment for them and perhaps they will do the studies for you.

The one big question with the whole set of studies is the availability of the laboratory capacity (and the willingness to do the analysis) for conducting the asbestos analysis of the soil samples. Based upon experience with other pollutants I suspect that the variation in results will be such that any reduction in the number of samples would reduce the reliability of the results down to the point that you could not meet any challenges from Johns-Mansville.

Originally we discussed simply installing a series of heaving gauges at the site. In my meeting with CRREL, I came away with the distinct impression that they were not all that sure that the use of the gauges alone would tell you anything about the asbestos other than to indicate that heaving was

occuring. The other problem with the gauges is the fact that they are a real temptation for young hands to pull on. I am doing some thinking about the tubes that I am proposing. These will be buried so that they are even with the surface. I may actually cover them so that they are not visible. A metal detector can be used to locate the locks and thus find the buried end of the tubes.

As you will note in the Work Plan, I am proposing to make measurements in the Fall and again in the Spring. This use of the frost year will allow us to determine the extent of heaving that has occurred over the winter months. The more that I read about frost heaving, the more I am convinced that we are likely to have materials moving up through the soil cover. The only thing that could cause a problem would be extensive snow cover for five or six years. We will have a good idea of the likelyhood as soon as the CRREL studies are completed.

Please feel free to call me about this Work Plan. There is nothing sacrosanct about it.

Sincerely yours,

Benjamin J. Mason

Benjamin J. Mason, PhD.
Principal Scientist

WORK PLAN FOR HUDSON, NEW HAMPSHIRE STUDY

A Report
Submitted By

ETHURA
P. O. Box 1280
McLean, Virginia 22101
(703) 569-0533

January 13, 1982

TABLE OF CONTENTS

WORK PLAN FOR HUDSON, NEW HAMPSHIRE STUDY

BACKGROUND

This study is designed to acquire data needed for determining the effects of frost heaving upon the buried asbestos found at six disposal sites located in Hudson, New Hampshire. These studies are to be done for the U.S.Environmental Protection Agency's Office of Hazardous Wastes Enforcement.

The sites range in size from less than one half-acre to approximately five acres. The largest site is the Meadow Site which is between four and five acres in size. Asbestos waste material in the form of fragments, broken sheets, bag waste and pelletized asbestos material. There is also a considerable amount of loose, "friable" asbestos and asbestos containing material. The broken sheets and fragments range in size from one quarter of an inch up to pieces of broken sheets of several square feet in size.

The area around Hudson is known to be in a zone where frost heaving occurs. The frost line extends down to about 36 inches in this area. There is a definite possibility that the pellets and the fragments of asbestos sheets will be heaved to the surface over a period of years. This study is designed to determine if the asbestos is moving toward the surface under the influence of frost action.

This is a new area of activity for environmental science therefore the methods used are somewhat experimental. It is believed that the methods outlined below will provide the needed data and will allow statistical reliability to be assigned to the results of the study.

A second area of interest is the vegetation cover placed over the disposal areas. The pH of the asbestos containing material is quite high and is likely to have an adverse effect upon the ability of plants to survive. This is further compounded by the fact that the shallow cover planned for the sites is not likely to provide adequate rooting depth for the plants to survive during the summer months. Studies are provided to aid in identifying the change in pH of the top soil and also to aid in evaluating the survival of the vegetation on the area covered by the Consent Decree.

INFORMATION SOURCES

The staff of the Soil Conservation Service and the researchers at the U. S. Army Corps of Engineers Cold Regions Research and Engineering Laboratory (CRREL) at Hanover, N.H. were consulted in developing the consent decree at the site. Discussions with the CRREL staff played an important part in developing this work plan. The ideas for the frost heaving studies are primarily the ideas presented by the CRREL staff. They were also helpful in identifying potential problems with the revegetation plans.

A number of standard reference texts were used in designing the vegetation and soils studies. These are listed in Appendix A.

OBJECTIVES

1. Determine the magnitude of frost heaving at the sites chosen for study.

2. Determine if asbestos materials are being heaved through the top soil.

3. Determine if the pH of the surface soil is being altered by moisture movement from the asbestos fill into the top soil.

4. Establish photo reference points for monitoring vegetational changes.

5. Measure the vigor of the vegetation on the sites.

METHODS

FROST HEAVING STUDIES:

There are three sets of studies suggested for determining the effects of frost heaving on the materials deposited in the Hudson, N.H. disposal sites. Plans for these studies are presented below. Details of placement of frost heaving devices and the plot layouts are found in Appendix B.

- Determine if asbestos materials can be made to heave under simulated conditions.

- o Determine the extent of frost heaving on the site.

- o Determine if asbestos materials are heaving through the soil cover placed over the disposal sites.

1. Sites:

Two sites have been chosen for the frost heaving studies--the Matarrazo Site and the Meadows Site.

Matarrazo Site: This site represents a dry situation where the water table lies below the asbestos fill material. The elevation of the asbestos above the creek and the depth of the fill material suggest that the water table will lie below the fill material during most of the year. This is further confirmed by profiles prepared by the defendant which show the depth of the asbestos and the water table elevations at the site. Studies on this site should represent the lower extremity of frost heaving

Meadows Site: This site represents the wet extremity of the study scale. The fact that the water table is well up in the asbestos fill materials suggest that this site should be the most likely to exhibit frost heaving of the asbestos. Heaving of the pellets known to be present at the site should closely parallel the heaving of small stones.

2. Studies:

Determine if asbestos materials can be made to heave under simulated conditions: The staff at CRREL have offered to subject the various asbestos materials found at the site to a series of bench tests to determine if these materials will frost heave through the soils that are to be used for the cover that will be placed over the sites. Samples of the asbestos materials will be collected at the Meadows site and at the Virginia Avenue Site for use in the tests. This will be coordinated with CRREL to insure the proper handling and availability of equipment for the studies. Johns-Manville will be contacted to determine the source of the cover material that they will use on the site. Samples of this soil will be obtained for use in the laboratory studies.

Five control samples of the various asbestos materials and five control samples of the cover soil will be submitted to either the NEIC laboratory or the Region I laboratory for

asbestos analysis and also for total chemical analysis. The results of the analyses will be used to determine the extent of movement of the bag waste material up into the cover soil.

The procedures used will be similar to those outlined in the CRREL publication "Freezing Test for Evaluating Relative Frost Susceptibility of Various Soils" by Chester W. Kaplar (Kaplar 1974). Two tests will be run. One will test to determine if the asbestos waste materials from the site will heave. The second will determine the movement of the asbestos materials up through the cover soil materials. If possible, soil columns that are long enough to simulate the fifteen inch cover proposed in the Consent Decree will be used. This will require a column comprised of fifteen inches of cover soil and an appropriate depth of asbestos materials. Upon completion of the freezing tests, the soil columns will be very carefully sampled to determine the degree of movement of the fine asbestos materials upward into the cover. Four samples will be taken from each two inch layer beginning at the interface and extending upwards through the column. The four samples in the interface layer will be analyzed first. If these show the presence of asbestos then the next two inch layer will be analyzed. This will continue until no further samples show the presence of asbestos fibers above the background level found in the cover soils.

At the same time that the samples are being taken, the column will be examined to determine if the asbestos fragments and pellets moved up through the cover soil. The soil scientist will be present for the sampling and for the examination of the soil columns both before and after the freezing study. He will be available to assist the CRREL staff at these times if he is needed.

Determine the Extent of Frost Heaving on the Study Sites: A technique that has not been used in pollution control work in the past will be used to determine the extent of frost heaving over the study site. A series of nine tubes will be buried in the interface zone between the asbestos and the cover soil. These tubes are used to measure changes in elevation that result from frost action.

A trench will be dug down to the point where the asbestos fill material is encountered. The bottom of the trench will be graded so that the bed for the tube is level. One inch diameter, flexible, plastic tubing will be placed in the bottom of the trench then backfilled with the cover soil. The soil will be tamped to approximate the density of the fill material over the entire site. The tubes will be outfitted with a locking cap for protection. After the tubes are installed, they will be filled with anti-freeze. A small pressure transducer will be drawn through the tube so that measurements can be taken at every one foot interval. The differences in elevation can then be

calculated from the variations in pressure measured by the transducer. Measurements will be repeated in the Fall and in the Spring of each year of the study. Differences in the elevations measured will be an indication of the degree of heaving at each measured point.

The data collected during the study will be subjected to statistical analysis, Kriging and a map will be prepared showing the isopleths of change in elevation of the tubes. These changes reflect the amount of heaving of the soil in the area and should reflect the amount of heaving that an object such as an asbestos fragment would be expected to exhibit during the same period of time.

The tubes can be removed at the conclusion of the study if this is deemed necessary. If they are to be removed, they will be carefully excavated and the trench refilled and the disturbed area reseeded.

Determine if Asbestos Materials are Heaving Through the Soil Cover Placed Over the Disposal Sites: The only way to provide a definitive answer to the question of frost heaving of the asbestos is to collect samples in a statistical design and to analyze the samples for asbestos fibers. This portion of the study will use this approach.

Nine plots will be located in each study area. At each plot three soil cores will be taken with a soil punch. The cores will be sampled at a point two inches below the interface between the cover and the fill, at two inches and at four inches above the interface. Each sample will be analyzed for asbestos fibers. In addition to the samples for asbestos, field pH measurements will be made at every two inches in each core. The holes created by the sampling will be refilled with clean cover soil and marked with an anodized knitting needle so that they will not be resampled at a later date. They will then be refilled with clean cover soil.

The data collected will be statistically evaluated according to the design presented below. If the asbestos is moving upward, the spacing of the samples may be altered or else additional samples may be taken at shallower depths. The location of the plots is shown in Appendix B.

VEGETATION STUDIES:

The vegetation on the sites is a vital part of the remedial measures undertaken in the Consent Decree. As was mentioned earlier, the effects of the shallow cover and the high pH may lead to a reduction in the density and vigor of the vegetation on the various areas. A series of studies is recommended that will provide a measure of the effectiveness of the vegetation cover on the sites. These studies will meet the following objectives.

- o Determine the density of the vegetative cover on the sites.
- o Determine the vigor of the vegetative cover.
- o Determine if there is a correlation between the vigor, density and pH on the site.
- o Establish photo reference points for each site.

The vegetation patterns and density will be determined by use of a set of at least five parallel line transects established across the site. The transects will be located approximately as noted in Appendix B. The end points will be permanently marked with a steel pin. A surveyors tape will be stretched between the steel pins to establish the actual sampling transect. Photo reference points will be established at nine points on each site for obtaining permanent photographic records of the vegetation at the nine sampling locations.

1.Vegetation Density Study:

The principle used in these studies is based upon the simple fact that when a sharply pointed rod is let down through the vegetation it either hits a plant or it does not. A record of an infinite number of such hits and misses gives the horizontal distribution of the vegetation. The number of hits divided by the total number of points measured gives a measure of the density of the vegetation.

The line transect is a means of controlling the distribution of the points taken. A steel surveyors tape establishes the line transect. The projection of the vegetation up to the tape is noted at the appropriate distances along the transect. This allows the investigator to determine not only the percentage of the area that is covered with vegetation but it also allows him to determine the percentage species composition at the same time. This technique will be used in the studies at Hudson, NH.

2. Vegetation Vigor Study:

One of the best measures of vigor is the height of the vegetation. This is usually determined by measuring a number of samples of vegetation at points along the line transect. The height of five members of any species found at every ten foot mark along the steel surveyors tape will be determined. The height will be measured with a steel tape measure. The height of the tallest five pieces of vegetation or each plant will be measured and recorded.

3. Vegetation Vigor - Soil pH Correlation Study:

Soil Samples will be taken at each vigor sampling point. Soil pH measurements will be made on two inch increments of a fifteen inch core taken with a King tube sampler. pH will be determined on a soil paste using a method similar to those presented in many standard soil testing manuals.

4. Photographic Reference Points:

Photographic reference ponts will be established at nine equally spaced locations on each site. Either a 35 mm or a 2 1/4" X 2 1/4" camera will be used to record the vegetation pattern and vigor at each permanent location. This will be accomplised by placing the camera on a tripod equipped with a head designed to allow the camera to be offset by the appropriate amount to allow stereoscopic viewing. Three photographs will be taken at each location. There will be a sixty percent overlap in each photo thus providing adequate coverage for measurements to be made from the photographs. A scale will be included in each photograph for reference purposes.

In addition to the above photographs, a panoramic photo will be taken at the center plot showing the general character of the site. These photographs will provide a permanent record of the vegetation on the site.

STATISTICAL DESIGNS AND DATA PRESENTATION

The statistical designs used in the three studies are each slightly different therefore they are listed in Appendix C for each study. The appendices give the basic variables tested and the analysis of variance used to evaluate the data. Where depth is a variable, an attempt will be made to use regression analysis to provide a stronger test than could be provided by analysis of variance alone. In those cases where regression can be used, a set of figures will be developed that shows depth versus the number of asbestos particles per gram of soil.

The vegetation and the frost heaving studies have been designed in a systematic grid pattern. This was done in order to provide data for developing maps of the spatial distribution of frost heaving, pH, vegetation vigor and vegetation density over the area. A technique called Kriging will be used to develop a map of the variables along with a statistical error map of the data collected. The error map can be used to determine the coverage of the data collected as well as its reliability.

A write-up of the results will be prepared upon completion of each study. In addition, at the end of each seasons sampling for vegetation vigor and frost heaving a report of the results will be prepared. These reports will not only present the data but will provide an interpretation of the results. This will allow the OHWE to make corrective action if such action is deemed necessary.

STAFFING

A soil scientist/agronomist and a field technician will be required to conduct the research outlined in this work plan. They will each be required to be on site for about two weeks at the time the plots are established then for one week at each sampling period after that. At the conclusion of the study, they will have to be on site to remove the various survey points and sampling tubes and restore any vegetation cover that is damaged by the removal of the equipment.

SCHEDULE

The schedule for this study cannot be definite due to the timing on the contract for initiating the work to be performed. The laboratory studies will require approximately three weeks for the frost susceptibility tests and approximately ten weeks for each test on a long column taken through five freeze-thaw cycles. A larger number of freeze-thaw cycles would provide a better test if time is available. The laboratory can handle four of the frost susceptibility tests at one time but can only accomodate one of the longer column studies unless additional equipment is purchased.

The field work will require approximately three days of preparation prior to the field work and approximately one week in the field for each study period. Data reduction can be carried out after the analytical results are available and should take from one to two weeks. By the time the first data is available, statistical programs will be available for rapid analysis of the data. The timing of the analysis will be the major factor in determining the schedule for the report of each years observations.

APPENDIX A

REFERENCES USED

APPENDIX A

REFERENCES USED

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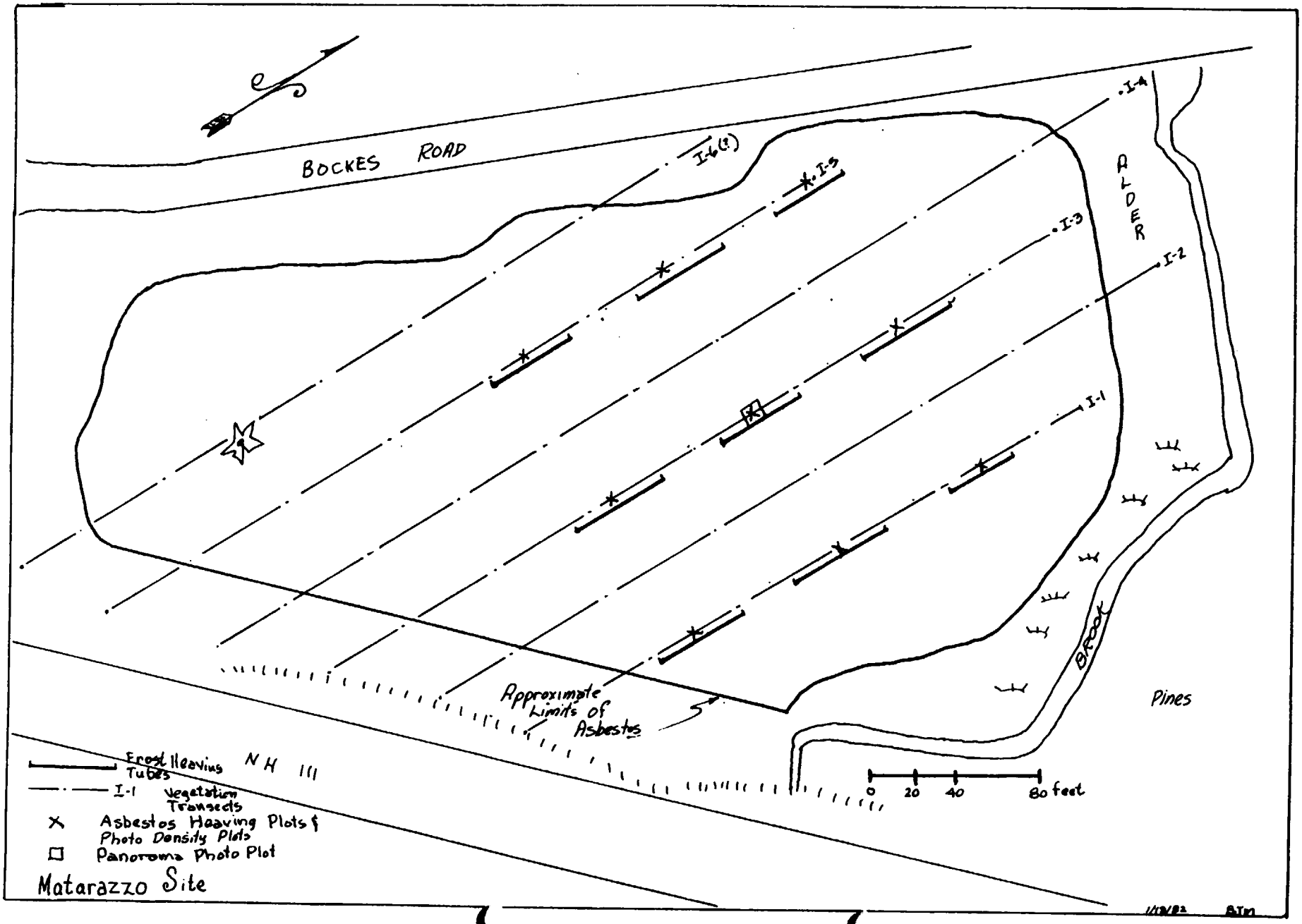
APPENDIX B

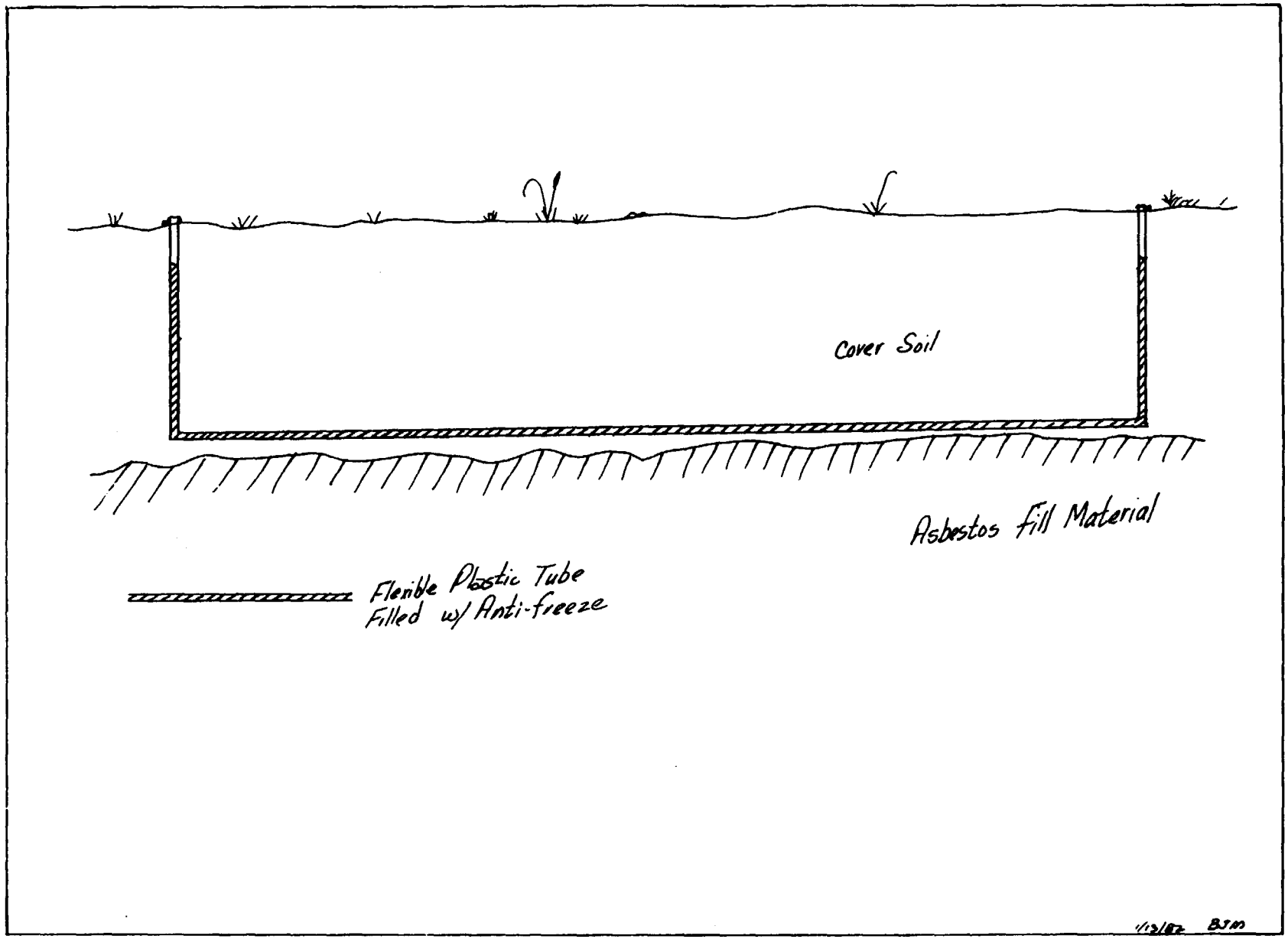
PLOT LAYOUT

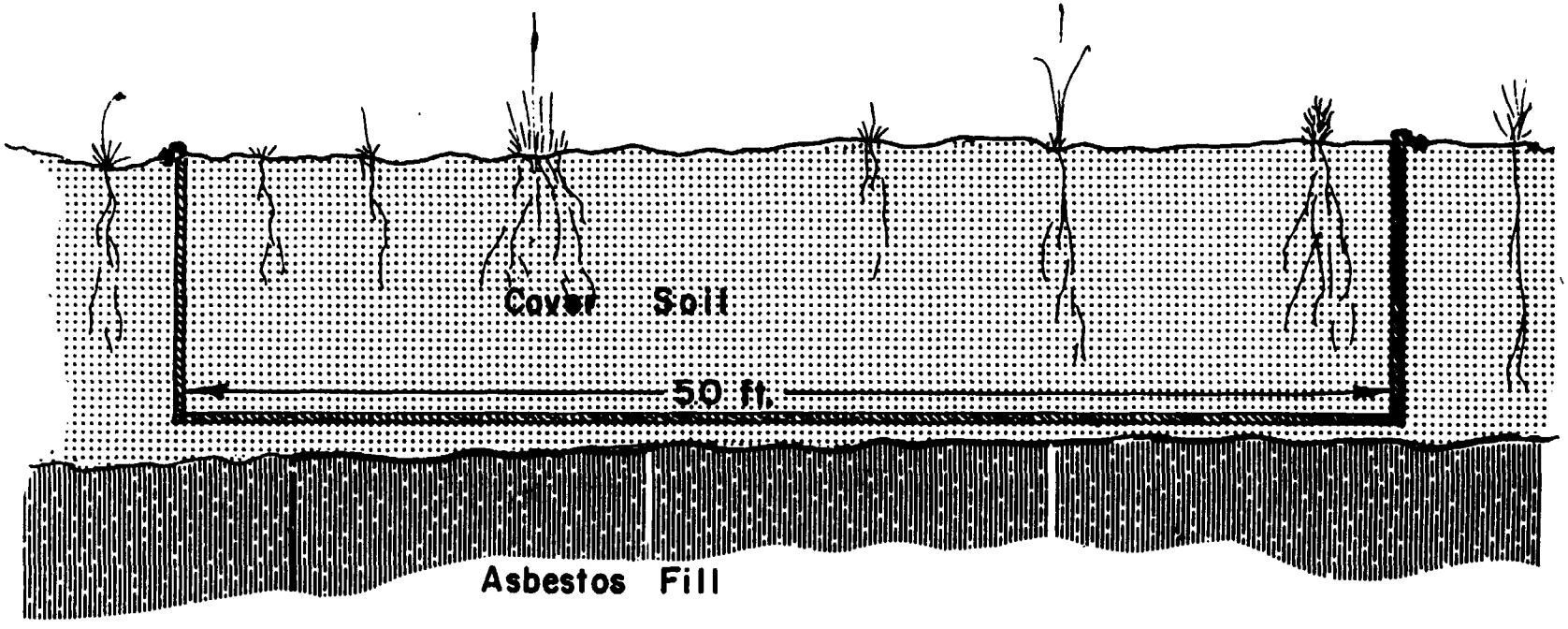
APPENDIX B

PLOT LAYOUT

This appendix presents the plot layout for the various study areas to be used in each study. The appendix also includes conceptual drawings of the various measurement devices to be used in the study. The captions determine the information needed to interpret the drawings.

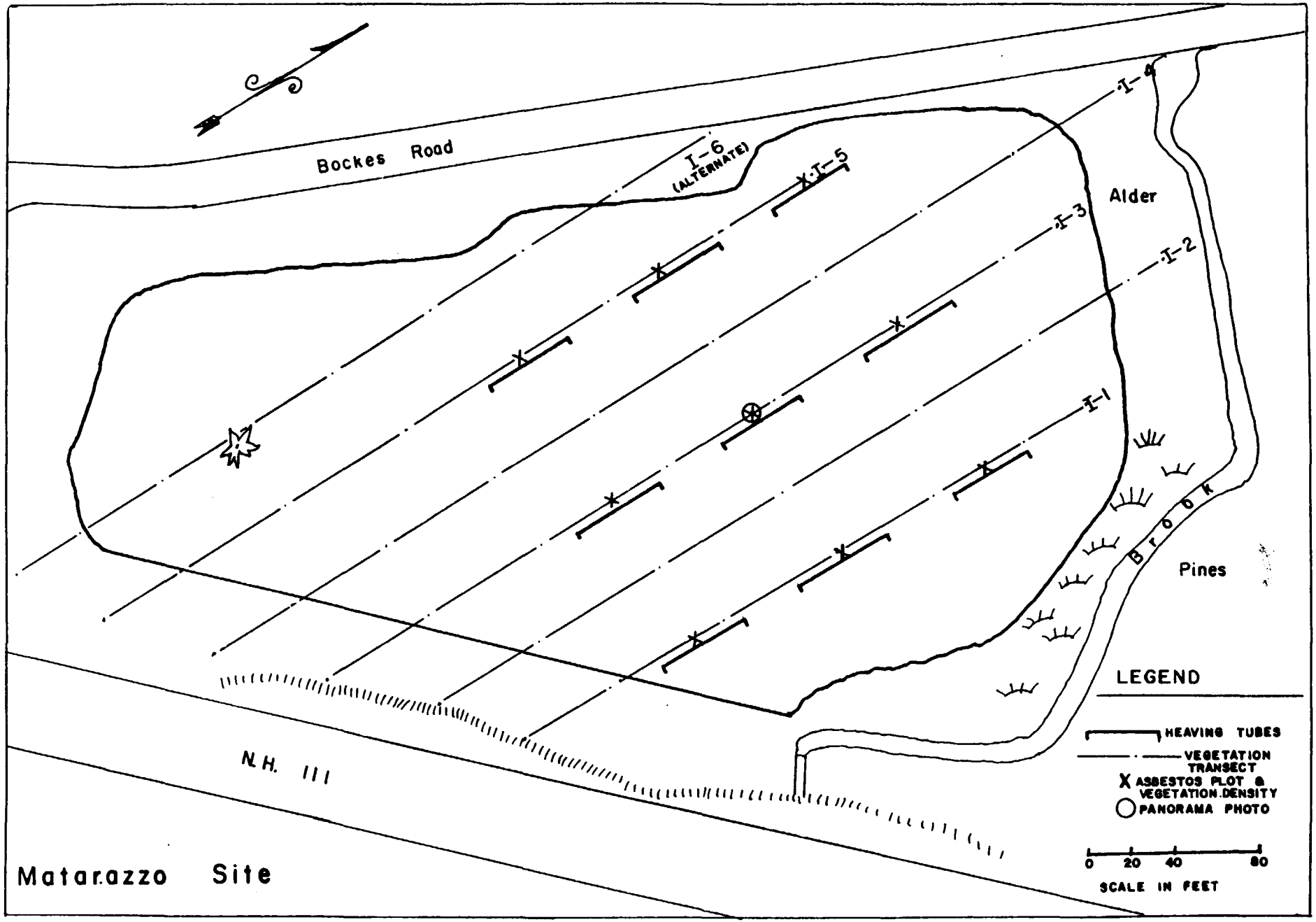

BOCKES ROAD
I-6(?)
I-5
I-4
I-3
I-2
I-1
ALDER
BROOK
Pines
Approximate Limits of Asbestos
NH 111
0 20 40 80 feet
Frost Heaving Tubes
I-1 Vegetation Transects
Asbestos Heaving Plots & Photo Density Plots
Panoroma Photo Plot
Matarazzo Site

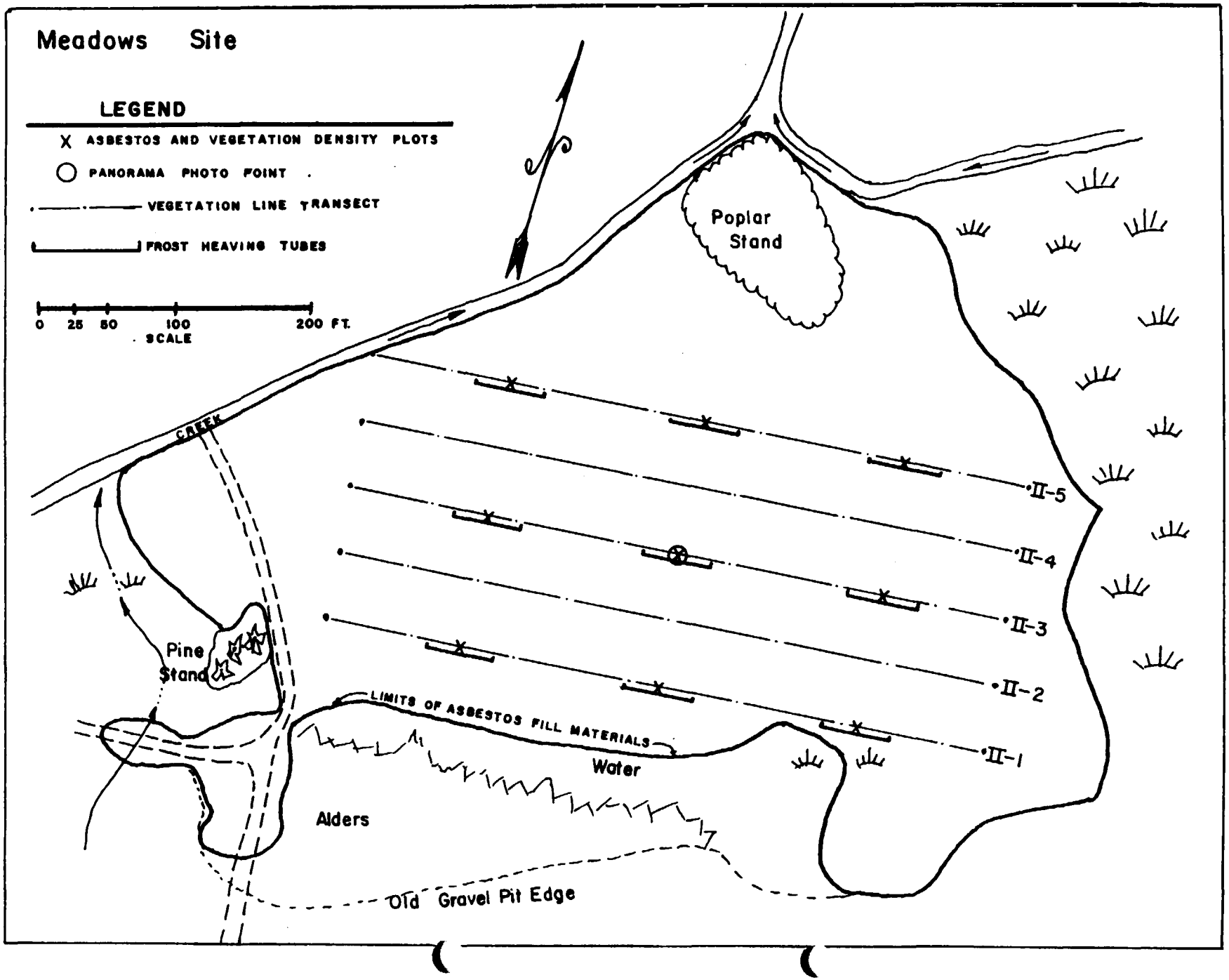

Cover Soil
Asbestos Fill Material
Flexible Plastic Tube
Filled w/ Anti-freeze
1/13/82 BJM



Flexible Plastic Tube Filled With Anti-freeze.

Design of Frost-Heaving Tube Plot.


Bockes Road
I-6 (ALTERNATE)
I-5
I-4
I-3
I-2
I-1
Alder
Pines
BROOK
N.H. 111
Matarazzo Site
LEGEND
HEAVING TUBES
VEGETATION TRANSECT
X ASBESTOS PLOT & VEGETATION DENSITY
PANORAMA PHOTO
0 20 40 80
SCALE IN FEET


Meadows Site
LEGEND
X ASBESTOS AND VEGETATION DENSITY PLOTS
PANORAMA PHOTO POINT
VEGETATION LINE TRANSECT
FROST HEAVING TUBES
0 25 50 100 200 FT.
SCALE
Poplar Stand
CREEK
II-5
II-4
II-3
II-2
II-1
Pine Stand
LIMITS OF ASBESTOS FILL MATERIALS
Water
Alders
Old Gravel Pit Edge

APPENDIX C

STATISTICAL DESIGNS

APPENDIX C

STATISTICAL DESIGNS

LABORATORY STUDIES:

1. Frost Susceptibility Study:

Study Description: Six cubic feet of the asbestos fill material will be brought into the laboratory at CRREL for tests to determine if the material is susceptible to heaving. Four columns six inches long and six inches in diameter will be prepared from the asbestos fill materials. These materials will be placed into the columns so that they have a density approximately the same as that found in the field. Freezing will occur according to the standard procedures used at CRREL. It is expected that the total freezing time will be about 12 days with several days being required on either side of the test for preparation and data collecting.

There is a possibility that more than one material will be tested. The number of types of materials will be determined after consultation with the field people from Region I. Bag wastes and other friable materials used as fill will be chosen as the main materials for the tests.

Analysis: At the conclusion of the freezing period the columns will be removed from the study chambers, the asbestos fill materials removed from the columns and the material sampled for analysis. Each column will be cut into three segments, and four sub-samples collected from each of the segments. The four sub-samples will be analyzed for percent moisture. An analysis of variance will be used on the data collected. The basic design is presented below.

Statistical Design: The following analysis of variance table presents the tests to be performed on the samples of fill materials that are collected.

Table C-1: Analysis of Variance for Frost Susceptibility Study.

Source of Variation	DoF	Mean Square
Fill Materials	1	$(\Sigma(T_m^2) - (\Sigma y)^2)/1$
Columns	6	$(\Sigma(T_c^2) - \Sigma(T_m^2))/6$
Layers Within Columns	16	$(\Sigma(T_l^2) - \Sigma(T_c^2))/16$
Error	72	$(\Sigma(y^2) - \Sigma(T_l^2))/71$
Total	95	$(\Sigma(y^2) - (\Sigma y)^2)/95$

2.Frost Heaving Study:

Study Design: The major component that is expected to move up through the cover material, if there is any movement, will be the board fragments and the various pellets found on the sites. Samples of these materials will be mixed with bag wastes for use in the laboratory heaving studies. These materials will be packed into columns that are 48 inches X 6 inches in size. The facilities for testing these larger columns are limited so that only one column can be tested at a time. Samples of the cover soil will be packed above the asbestos waste materials to a density similar to that found at the site. Every effort will be made to obtain samples of the actual cover soil that will be used on the sites. The depth of soil may have to be limited in order to reduce the time of the tests.

The time to conduct these studies is quite long in comparison to the studies mentioned in paragraph 1 above; therefore it is possible that only one or at best two columns can be evaluated in the time available for the study. The soils will be allowed to freeze to a depth that reaches into the asbestos materials. This is expected to take about ten days. The samples will then be allowed to thaw for approximately five days. This cycle will be repeated at least five times. The last cycle will be followed with a freezing period.

Analysis: The column will be removed from the chamber, cut in half, examined for visible signs of movement of board fragments and pellets, the columns will then be sampled at every two inches and the moisture content of each sample determined. After the moisture content has been determined, the samples will be submitted for asbestos analysis.

Statistical Design: The designs used in this study are similar to the one outlined above for the susceptibility study. Table C-2 presents the analysis of variance to be conducted on the data. If the materials move up through the column, regression analysis may be used to provide more information on the behavior of the asbestos than will be available from the simple analysis of variance tests.

Table C-2: Analysis of Variance for Frost Heaving Study Data.

Source of Variation	DoF	Mean Square
Type of Materials	1	$(\Sigma(T_m^2) - (\Sigma y)^2)/1$
Depth	14	$(\Sigma(T_d^2) - \Sigma(T_m^2))/14$
Error	48	$(\Sigma(y^2) - \Sigma(T_d^2))/48$
Total	63	$(\Sigma(y^2) - (\Sigma y)^2)/63$

FIELD FROST HEAVING STUDIES:

1. Frost Heaving Measurements:

Study Description: At each site, nine fifty foot long tubes filled with anti-freeze will be set into the interface between the asbestos fill material and the cover soil. A pressure transducer will be pulled through the tube measuring the variations in pressure along the length of the tube at one foot intervals. Distance along the tube and the pressure differences

will be recorded for later translation into measurements of elevation change.

Measurements will be made in the Fall and in the Spring of the following year. The changes in elevation will be a measure of the amount of frost heaving on the site during the winter months. This method is very sensitive to the movements that are likely to occur during the course of a year.

Analysis of Data: Statistical techniques that are available for analyzing the data from a systematic sampling plan similar to that used on this study are limited in their usefulness for determining the degree of frost heaving on the site. A technique that has been developed for use in the mining field has been used effectively to evaluate spatial data similar to that collected in this study. One of the unique features of Kriging is the fact that not only can the investigator develop a good map of the variables of interest but he also can develop a map showing the statistical error over the area covered by the study. This provides a measure of the reliability of the data and assists in deciding if additional samples are needed and where they should be located. This technique will be used on the tube sampling data.

2. Measurement of the Movement of Asbestos:

Study Description: Nine equally spaced sampling locations will be established on each area. A King tube will be used to collect three core samples of the cover soil from the surface at each sampling location. The cores will be approximately 18 inches long so that they cover the zone extending down to the top several inches of the fill material. Each core will be sectioned into two inch increments; the first being collected in the fill material. A portion of the in each section will be tested for pH using a field pH meter. The remainder of the soil will be submitted to either the NEIC or the Region I laboratory for asbestos analysis.

Analysis: The samples collected during this study will be analyzed for pH in the field and for asbestos in the laboratory. The sample from the fill material will be used for a control of the type and amounts of asbestos present at a particular location.

Only the lower four inches will be analyzed during the first year unless the analysis indicates that the materials have moved further up into the soil cover. If this happens then the

upper layers will also be analyzed. In subsequent years a longer length of the core will be used for a sample under these circumstances. It may be desireable to collect triplicate samples at one location out of the nine. This provides a measure of the reliability of the analysis on the samples.

Statistical Design: The following analysis of variance table presents the statistical tests to be applied to the data collected from this portion of the study. If there is movement up through the soil cover, regression analysis may also be used on the data. This will allow a prediction equation to be developed that may prove to be useful on other sites in the area.

Table C-3: Analysis of Variance for Asbestos Movement Study.

Source of Variation	DoF	Mean Square
Plots	8	$(\Sigma(T_p^2) - (\Sigma y)^2)/8$
Depths	19	$(\Sigma(T_d^2) - \Sigma(T_p^2))/18$
Error	54	$(\Sigma(y^2) - \Sigma(T_d^2))/54$
Total	80	$(\Sigma(y^2) - (\Sigma y^2))/80$

VEGETATION STUDIES:

1. Vegetation Density Study:

Study Description: The vegetation density studies will be conducted using a line transect method for determining the density of the ground covered by vegetation. The form presented later in the Appendix indicates the types of data being collected. Five transects will be established across each of the

sites. These will provide adequate coverage for the area and also allow a reliable measure to be made of the density.

Each transect will be from 300 to 500 feet long and run north to south across the sites. (This direction may have to be changed inorder to provide more uniform coverage of the areas covered by the asbestos.) Observations will be made at every inch mark on a 500 foot steel surveyors tape. Any plant lying under the width of the tape will be counted. If the area under the tape is bare this will be appropriately recorded.

Analysis of Data: The data collected during the field work will be processed to develop the percentages of ground cover and the percentages of each species present.

Statistical Analysis: There will be no statistical analysis of the data prepared on this study. There is a possibility that some modification of the Kriging technique will be attempted; but, at this time no statistical test is planned.

2. Vegetation Vigor Study:

Study Description: Vegetation vigor will be determined by measuring the height of five members of any species found at or close to every ten foot mark on the line transect. This will give 250 sample points to use in determining the vigor of the vegetation on the area. The determination of vigor will be made by measuring the five tallest pieces of vegetation on each plant measured. These measurements will be recorded on an approprate data form.

In addition to the vegetation data, a pH measurement of the root zone will be taken at each point where vegetation vigor is determined.

Analysis of Data: The data collected will be processed in the office. A measure of the vigor will be determined by calculating the mean and the standard deviation of the data for each species encountered on the site.

Statistical Analysis: The data will be subjected to analysis of variance according to Table C-4. If the data lends itself to regression analysis, this test will be used to develop a measure of the effects of pH upon he vigor of the vegetation.

Table C-4: Analysis of Variance of Vegetation Vigor Data.

Source of Variation	DoF	Mean Square
Transect Lines	4	$(\Sigma(T_t^2) - (\Sigma v)^2)/4$
Points on Line	245	$(\Sigma(T_p^2) - \Sigma(T_t^2))/245$
Plants at a Point	1000	$(\Sigma(T_s^2) - \Sigma(T_p^2))/1000$
Error	5000	$(\Sigma(v^2) - \Sigma(T_s^2))/5000$
Total	6249	$(\Sigma(v^2) - (\Sigma v)^2)/6249$

APPENDIX D

EQUIPMENT AND COST ESTIMATES

APPENDIX D

EQUIPMENT AND COST ESTIMATES

EQUIPMENT LIST:

1. Equipment and Supplies to be Purchased:

A.	Flexible Plastic Tubing	1000 feet 1 1/2 in. od.
B.	Antifreeze	150 gallons
C.	Anodized Aluminum Pins	850
D.	Survey Stakes	100
E.	Sample Containers	1000
F.	Shipping Cartons	50
G.	Locks	40
H.	Caps for Tubes	40
I.	Film	25 rolls, 36 exposure.
J.	Forms for Data Collection	1000
K.	pH Buffer Solutions	2 pints
L.	Shovels	2
M.	Pressure Transducer	1
N.	Electricians Fishing Tool	2 100 foot long

2. Equipment and Supplies Provided by Contractor:

A. Transit
B. Datacorder
C. Surveyors Chain
D. Hand Tools
E. pH Meter
F. Digital Volt Meter
G. Camera (either 35mm or 2 1/4" X 2 1/4")
H. Tripod with Steroscopic Head
I. Soil Auger and Ring Tubes

COST ESTIMATES:

1. Costs for Laboratory Studies:

Providing Asbestos Materials for Tests	$ 300.00
Equipment for Second Long Tube (optional)	2,500.00
Labor provided by CRREL	?
Labor from Soil Scientist (optional)	1,000.00
Supplies Required for Tests	250.00
TOTAL (Depends on options.)	$?

2. Costs for Frost Heaving Study:

Costs for Annual Studies:

Soil Scientist	$ 5,000.00
Technician	4,000.00
Travel (Prorated for Number of Days)	3,200.00
Per Diem (Prorated for Number of Days)	3,500.00
Computer	500.00
TOTAL OPERATING COSTS	$16,200.00
COSTS PER YEAR	3,240.00

First Period Costs:

Labor	$ 1,800.00
Supplies and Equipment	2,200.00
Travel	150.00
Per Diem	450.00
Miscellaneous	150.00
Transducer	500.00
TOTAL SETUP COSTS	$5,250.00

3. Asbestos Heaving Studies:

Costs for Annual Studies:

Soil Scientist	$5,000.00
Technician	2,000.00
Travel (Prorated by Number of Days)	1,550.00
Per Diem (Prorated by Number of Days)	1,750.00
Equipment Rental	100.00
Computer	100.00
Sample Containers	500.00
Mailing Samples	250.00
Markers	400.00
TOTAL OPERATING COSTS	$11,650.00
ANNUAL FIELD COSTS	2,330.00

Analytical Costs:

Analyses are to be done by EPA laboratories therefore no cost can be identified at this time.

First Period Costs:

Labor	$ 600.00
Travel	50.00
Per Diem	150.00
Equipment Rental	150.00
Miscellaneous	50.00
TOTAL SETUP COSTS	$ 1,000.00

4. Vegetation Density Study:

Cost of Annual Studies:

Soil Scientist	$ 8,000.00
Technician	6,000.00
Travel (Prorated by Number of Days)	3,200.00
Per Diem (Prorated by Number of Days)	3,500.00
Supplies	100.00
TOTAL OPERATING COSTS	$20,800.00
COSTS PER YEAR	4,160.00

First Period Costs:

Labor	$ 300.00
Equipment Rental	50.00
Travel	25.00
Per Diem	50.00
TOTAL SETUP COSTS	$ 425.00

5. Vegetation Vigor Study:

Costs of Annual Study:

Soil Scientist	$ 4,000.00
Technician	2,000.00
Computer	500.00
Equipment Rental	100.00
Travel (Prorated by Number of Days)	1,550.00
Per Diem (Prorated by Number of Days)	1,750.00
TOTAL OPERATING COSTS	$ 9,900.00
COSTS PER YEAR	$ 1,980.00

First Period Costs:

The same as the annual costs from above	$ 1,980.00

6. Photographic Documentation:

Technician	$ 1,000.00
Film (Cost Plus Processing)	300.00
Equipment Rental	100.00
TOTAL PHOTOGRAPHIC COSTS	$ 1,400.00
COSTS PER YEAR	280.00

7. Site Closing Costs:

Labor	$ 600.00
Travel	150.00
Per Diem	450.00
Soil	100.00
Seed	100.00
TOTAL SITE CLOSING COSTS	$ 1,400.00

ANNUAL COST SUMMARY

Frost Year	Annual Cost
1982-1983	$14,630 + CORFL
1983-1984	11,950
1984-1985	11,950
1985-1986	11,950
1986-1987	13,350

TO Brad Bradley

U.S. EPA Region 5

SUBJECT Johns Manville FS

DATE 9 June 1986

MESSAGE The attached article by Debbie Dalton was copied from the proceedings of the 6th National Conference on Management of Uncontrolled Hazardous Waste Sites, published by Hazardous Materials Control Research Institute, Washington, DC. The conference occurred on November 4-6, 1985. Debbie Dalton is no longer with U.S. EPA, but has moved to Clean Sites, Inc. Her phone number there (last contacted in March) is (703)683-8522. If you have any other questions, please call me.

SIGNED John Digiulio

DATE

REPLY

SIGNED

RECIPIENT: REPLY ON PINK COPY — RETAIN WHITE COPY

U.S. EPA Enforcement Approach to Asbestos Site Cleanup

Deborah S. Dalton
U.S. Environmental Protection Agency
Office of Waste Programs Enforcement
Washington, D.C.

ABSTRACT

A number of asbestos-contaminated sites are listed on the National Priorities List or have been considered for U.S. EPA emergency actions. Of these, four have been the subject of intensive U.S. EPA enforcement efforts to obtain site cleanup by potentially responsible parties. Considerations used in selecting the appropriate remedial response at each of these sites will be discussed and the final cleanup action will be described.

INTRODUCTION

Superfund has been used to accomplish cleanup at a number of National Priorities List (NPL) and non-NPL sites where the primary or only contaminant of concern is asbestos. National Priority List sites include: Mountain View Mobile Home Estates, Globe, Arizona; Coalinga Asbestos Mine, Coalinga, California; Atlas Asbestos Mine, Fresno County, California; Ambler Asbestos Piles, Ambler, Pennsylvania. Non-NPL sites include ten sites in and around Hudson, New Hampshire; the Jaquays Mill site, Globe, Arizona; and the Lloyd Hodges site, East Chicago, Indiana. Many of these sites were or are involved in enforcement actions under RCRA §7003 or CERCLA §106.

In this paper, the author will describe the approach taken in selecting remedial action at sites which are/were the subject of intense enforcement involvement. Considerations used in selecting or approving the appropriate remedies at these sites will be outlined and the final cleanup actions will be described.

ASBESTOS

Scientific Status

The definition of asbestos listed in the Glossary of Geology[1] is:

- A commercial term applied to a group of highly fibrous silicate minerals that readily separate into long, thin, strong fibers of sufficient flexibility to be woven, are heat resistant and chemically inert, and suitable for uses (as in yarn, cloth, paper, paint, brake linings, tiles, insulation cement, fillers and filters), where incombustible, nonconducting, or chemically resistant material is required.

- A mineral of the asbestos group, principally chrysotile (best adapted for spinning) and certain fibrous varieties of amphibole (example: tremolite, actinolite, and crocidolite)."

Inhalation of asbestos fibers is known to cause cancer in humans. Specifically, exposure to asbestos can cause bronchogenic carcinomas in the lung and pleural and peritoneal mesotheliomas after a latency period of up to 30 years. Asbestos is also known to lead to respiratory asbestosis, characterized by fibrosis, calcification and fibrosis of the pleura.[2] There is very limited information from which to infer the danger of cancer from ingestion of asbestos fibers in food or drinking water.

Legal Status

Asbestos is listed as a hazardous air pollutant under the Clean Air Act (CAA), section 112. Asbestos air emissions are regulated by the National Emissions Standards for Hazardous Air Pollutants (NESHAPS) at 40 *CFR* Part 61, Subpart M. Asbestos is listed as a toxic pollutant under section 307(a)(1) of the Federal Water Pollution Control Act (FWPCA). Asbestos is regulated in workplaces by OSHA (29 *CFR* Part 1910) and in schools by the U.S. EPA under the Toxic Substances Control Act (TSCA).

Although asbestos is not a hazardous waste listed under the RCRA regulations (40 *CFR* Part 261), its disease-causing properties meet the standards of the statutory definition of RCRA §1004(s). This toxic property of asbestos allows use of the substantial hazard standard of RCRA §3013 and the imminent and substantial endangerment standard of §7003 for enforcement purposes. Because of its listing in CAA and FWPCA, asbestos is, by definition, a hazardous substance under CERCLA §101(14), enabling the U.S. EPA to take removal or remedial action with the Superfund or to take enforcement action for cleanup through administrative orders or judicial actions under §106, and for cost recovery under §107.

Several enforcement actions have tested the U.S. EPA's response and enforcement authorities. The U.S. EPA has prevailed in these actions. In 1983, after oral argument and testimony in U.S. v. Johns Manville *et al.*, the U.S. District Court of New Hampshire found "that there has been a release or there exists a substantial threat of a release in the environment of a hazardous substance as contemplated by §104(a)(1) of CERCLA" and ordered two defendants to allow the U.S. EPA access to their property to conduct a removal action (installation of a cap). In 1984, in U.S. v. Metate Asbestos *et al.*, the U.S. District Court of Arizona found, on a partial summary judgment motion, that asbestos is a hazardous substance under the definition at §101(14) by virtue of the fact that asbestos is regulated under Section 307(a) of FWPCA and under Section 112 of Clean Air Act. The court ruled against the defendants' interpretation of the RCRA exclusion of mining wastes.

SITE INVESTIGATION/CHARACTERIZATION

The development and selection of remedies at asbestos sites varies little in its process from the process used at any other hazardous waste site. On one hand, decisions are made easier because there is no information indicating subsurface lateral or downward movement of asbestos in a landfill and asbestos is not a regulated hazardous waste under RCRA subtitle C. However, site investigations are made more difficult because analysis and quantification of asbestos is both complex and difficult to interpret.

Sampling

As with any other hazardous waste site, it is important to determine the scope of the contamination and possible movement or transport of the hazardous substance off-site. Asbestos sites dealt with under Superfund have primarily been the result of waste disposal from mining, milling or manufacturing facilities in the immediate area of the site. Asbestos contamination of soils is the result of either on-site waste disposal activities or the result of off-site deposition of asbestos particles through soil erosion from surface water or wind. There is no evidence to date of significant subsurface downward or lateral migration in soils. However, there may be upward movement of asbestos particles or products due to freeze-thaw effects common to rock migration in northern and New England soils. There is no documentation of groundwater transport of asbestos particles.

Surface soils and soil cores should be taken to investigate the areal extent and depth of contamination at and around the site. Site vegetation can be sampled after a wind or rain storm to investigate whether asbestos may have been transported from the soil, into the air and resettled on vegetation. Wipe samples should be taken from buildings or equipment on-site. If the site contains buildings or equipment which have air filters, these filters can be sampled.

Air sampling may be the next logical step. This analysis requires fairly sophisticated design procedures and may involve weeks or months of continuous sampling with many air sampling devices. Prior consultation with specialists in asbestos and particulate sampling is recommended, particularly if an enforcement action is involved. Experts differ in their desire for air sampling data to support their testimony that populations on or surrounding the site may be endangered. It is very difficult and potentially very costly to design an air sampling program which actually produces results useful for estimating population exposure.

Modelling studies may be quite useful in estimating typical and worst case air transport if the following information is available: meteorological conditions (wind direction and speed, temperature), soil and asbestos particle size and density, soil and air moisture conditions, site activity, site topography and asbestos concentrations. It may be time-consuming and of questionable cost-effectiveness to attempt to verify modelling results with an intensive air sampling regime, depending on the estimated cleanup cost for the site and the financial viability of responsible parties.

As with any site, historical land use records and photographs may be useful in directing the sampling efforts. Because visible emissions from asbestos milling, storage, manufacturing and disposal sites are a violation of NESHAPS, photographs or documentation of these occurrences may be valuable both for their evidence of the air transport of the wastes and as a basis for a Clean Air Act count in any enforcement action.

Information about site activities is also useful in alleging or estimating exposure to asbestos. In one toxic torts case, the plaintiffs went so far as to operate lawn mowers, motor bikes, rototillers, etc. on a residential site with personnel monitors and environmental air monitors to record the asbestos entrained in the air and available in the breathing zone. This may or may not be necessary, fruitful or desirable depending on the needs of the asbestos experts retained to work on the case. Some small amount of literature exists which could be extrapolated to these activities. Case-specific decisions should be made balancing costs, benefits and uncertainties.

Analysis

There are a number of uncertainties resulting from the difficulties of selecting a method of analysis, performing the analysis and interpreting and applying the results. A number of methods are used for the identification and quantitation of asbestos in air water and soils. Optical polarized light microscopy, transmissio electron microscopy, scanning electron microscopy and x-ray diff raction are useful but limited methods. Langer[3] describes thes methods in some detail.

Electron microscopy is most expensive and takes the longest tim to perform but will detect the smallest fibers. Polarized light micro scopy can be done on-site or by many nearby laboratories for les time and money, but may be limited in its detection capabilities If the point of the sampling is to demonstrate to the court that as bestos has definitely been released into the air and cost and time ar not obstacles, then electron microscopy may be the method o choice.

If real time monitoring data are needed during a phase of clean up, then an on-site laboratory with polarized light microscop capabilities may be the most useful. Choose the analytical metho that best fits your short- and long-term needs, timing and budge Consult with your analytical laboratory during the design of sam pling plans so that the analytical regime matches the rigorousnes of your sampling. If you are involved in an enforcement case, con sult with your asbestos expert witnesses regarding their needs an experience.

The most difficult problem is to relate the number of percen tage of fibers reported in the analysis to the quantity of asbestos i a soil sample. A direct concentration (ppm or % by weight) is nc reported; rather, analysts give the number or percentage of asbe tos fibers per microscope field examined. Relating these data t traditional methods of interpreting data and estimating exposur potential is difficult. Air samples offer seemingly more direct re sults of numbers of fibers per liter of air across the filter. How ever, the sampling design is more difficult because the variable may be more difficult to control.

In general, it can be logically argued that asbestos documente on the surface of a site can be, and is, transported off-site by win and by surface water runoff, to later be available for re-entrain ment and subsequent exposure.

FEASIBILITY STUDIES/REMEDIAL DESIGN

At this point in time, there is only one option for permanen disposal of asbestos; that option is burial. There are several ways t accomplish this result depending on the size of the site and th volume of asbestos-contaminated soil: (1) excavation, transport off-site landfilling; (2) burial in an on-site pit or landfill; (3) ca in place.

Because asbestos is neither a waste listed nor regulated unde RCRA, disposal sites do not have to conform to subtitle C stan dards. Off-site disposal of asbestos wastes from a Superfund sit may require a justification to be exempt from the U.S. EPA OSWER Off-site Disposal Policy which requires Superfund waste to be disposed of only at sites with RCRA permits and a good com pliance record. At the time of this paper, the issue had not bee raised on a site-specific basis. However, adequate arguments tha asbestos wastes do not require the groundwater protections inher ent in the Subtitle C landfill permitting process can be made. Gen eral requirements for solid waste disposal under RCRA do appl (40 *CFR* Part 257).

Under the Clean Air Act, NESHAPS requires closure of an as bestos site by covering the asbestos material with at least 6 in. o compacted clean fill material and vegetation or 24 in. of com pacted clean fill material (no vegetation) or a resinous or petroleun based dust suppression agent. The drawback of the latter method i that the dust suppression agent must be reapplied at least yearl to maintain maximum effectiveness.

A general discussion of asbestos waste management is given i U.S. EPA publication number 530-SW-85-007, May 1985, en

titled "Asbestos Waste Management Guidance."[4] Choice of a remedial option should be based upon a number of factors in addition to RCRA and NESHAPS. In some cases, the minimum required standards may be inadequate for a long-term remedial response. As mentioned above, dust suppression agents have a finite short life, 6 in. of fill may not be an adequate cap in difficult climates or steep topography and vegetation may be difficult to establish or maintain. In its enforcement actions, the U.S. EPA has focused on obtaining a remedy adequate for 30 to 50 years.

The following considerations have been used in selecting, recommending and/or approving remedies at RCRA and Superfund enforcement sites:

- Present site use, extant buildings and structures
- Site accessibility to the public
- Concentration of asbestos in the soil or wastes
- Volume of asbestos-contaminated soil or wastes
- Areal extent of surface contamination
- Depth of contamination
- Site safety procedures during remedial work
  Topography
  Climate—temperature, rainfall, storm events
- Vegetation establishment and maintenance
- Future maintenance requirements
- Future use

Decision #1: On-Site or Off-Site

The first decision to be made is whether the remedial action should take place on-site or off-site. The primary considerations in making this decision are site use, site accessibility and the concentration and volume of asbestos contaminated soil on the site. Future use may also be a consideration if the site is zoned for residential or industrial use.

The extent and volume of contamination contribute directly to the decision as to the practicality and cost of excavation and off-site transport. On several sites in New Hampshire, asbestos manufacturing bag wastes were used as fill in marshy areas or ravines. Because of the depth of possible excavation and the large amount of waste to be transported, it was deemed more cost-effective to p the wastes in place. The concentration of asbestos in the soil ıd the accessibility of the site also contribute to the decision to excavate or cap in place.

On several smaller sites in New England, there was only a small surface area a foot or so in depth of contaminated soil. In these cases, it was more practical and more protective of health to remove the contamination and transport it to the local landfill for proper burial.

Residential sites should be looked at carefully to analyze the types and locations of activity and the locations of asbestos contamination. Certain typical suburban activities such as gardening and landscaping may preclude on-site disposal or capping.

As a result of a scope of contamination study performed at Mountain View Estates, Globe, Arizona, it was found that there was a fairly uniform distribution of asbestos over each residential lot. To adequately protect residents continuing to reside in the subdivision, there were three options other than permanent relocation: (1) installation of a cap in excess of 5 ft, (2) installation of a lesser cap with restrictions on any gardening, or (3) heavy use of the lots for recreational uses or (3) complete removal of all asbestos-contaminated soil. These options were rejected upon consideration of these and other factors discussed below. At one site in New Hampshire, a pocket of asbestos-contaminated fill was removed from a residential lot because it was deemed more protective of health and was feasible and cost effective to excavate.

A decision to transport off-site necessitates excavation of the wastes; and consequently, the health and safety of workers and nearby residents during the excavation and transport of the wastes, whether to an off-site or on-site landfill, is of concern. The scope and intensity of protective measures will affect the cost and feasibility of the job and the oversight required.

Residential Site Considerations

If there are residences on or adjacent to the site, sampling of settled dust should be done in those residences to determine whether asbestos has been transported from the site into them. Where there is information that asbestos attributable to the site is present in any building (aside from asbestos that may have been installed as insulation, siding or flooring) a decision must be made as to the feasibility of cleaning the building and its contents. A company skilled in asbestos cleanup in buildings should be consulted in the early stages of design to determine the best procedures and timing for cleaning.

It may be necessary to temporarily relocate nearby residents during times of intensive site work and building cleaning activities. The U.S. EPA temporarily relocated several families adjacent to sites in New Hampshire based on recommendations of the Centers for Disease Control and the judgement of the On-Scene Coordinator assisted by an industrial hygienist.

Permanent relocation is an option that should be considered the same time period as the decision for off-site or on-site dı posal. The U.S. EPA permanently located more than 20 families from mobile homes at the Mountain View Estates in Globe, Arizona, after deciding that the mobile homes could not be cleaned adequately unless the interior panel walls were removed and the air spaces between the walls were cleaned. Interior walls in mobile homes are not air tight; air and dust can infiltrate the spaces between the walls. One option was to purchase new trailers for installation on site. However, because of the uniform distribution of the asbestos contamination of the site, it was felt that a cap in excess of 5 ft might be needed to allow for normal suburban residential activities on the property. This was deemed to be not cost-effective. The residents were brought out; title to the property was assumed by the State of Arizona.

Decision #2: Cap in Place or Create On-Site Landfill

If it is decided to complete the remedy on-site, the second decision is whether to cap the contaminated area in place or to ex cavate and place the material in a burial pit or an on-site landfill Again, the volume of the waste is a primary consideration.

Topography or the physical characteristics of the disposal site are also considerations because of wind and water erosion. If the wastes are in a large tailings pile or on a steep slope, it may be more secure for the long-term to remove the wastes to a burial pit or an area where they can be leveled off to the surrounding topography. A soil cover over a large steep sided pile may be a measure requiring a high degree of future maintenance because of the increased possibility of erosion. Health and safety considerations for workers and the surrounding population may play a part in the choice of capping in place or excavation to a new landfill site.

Cap Design

The design of a cap need not be strictly in accordance with RCRA regulations because, in the case of an asbestos closure, the cap serves a more limited purpose than for normal hazardous wastes; for asbestos, the purpose of the cap is to prevent remergence of the wastes on the surface of the site through the processes of wind and water erosion, freeze/thaw cycles and site use. At U.S. EPA enforcement sites, the nominal depth of the soil cap has varied from 6 in. to 5 ft, depending on topographical features, rainfall, winter temperature extremes, vegetation requirements, future maintenance requirements and future uses. Caps have been

finished off with gravel, rip rap and/or vegetation depending on the foreseeable maintenance requirements, climate and aesthetics. In most enforcement actions, the U.S. EPA has been reluctant to accept the 6-in. plus vegetation minimum under NESHAP because of doubts about how long the cap would last due to erosion and continued site use.

The Corps of Engineers at the Cold Regions Research Laboratory in Hanover, New Hampshire has recommended a minimum of 2.5 ft of soil as a cap for New England sites because of research which found that there is an annual upward movement of pebbles, rocks and presumably asbestos particles through the action of freezing and thawing.[3] They recommend that the top of the asbestos layer be lower than the mean freeze line in the soil after the cap is installed.

The Arizona-Nevada Area Office of the Corps recommended a minimum of 2 ft of cover fill material at the Mountain View Estates site because of the desert climate and the potential for heavy storm erosion. The State of Arizona will assume maintenance responsibilities for this site after construction. However, a 5 ft layer of soil was chosen at the adjacent Jaquays site because of the higher concentration of asbestos in the tailings and the need to design a remedy with minimal future maintenance by the owner/operator.

Liners have been used at several sites, primarily to stabilize excavations or to indicate extensive erosion. The liners have been both PVC and woven filter fabric and have been used on top of rather than under the asbestos contamination. In Ambler, Pennsylvania, a matting layer of paper fibers in polypropylene was used on top of the clean fill to stabilize the steep slopes of the asbestos piles during the time it took for the vegetation to become established. Because there is no information that asbestos migrates downward or laterally, a bottom liner is not needed.

The depth of the cover or cap is relevant also to the ability to establish and maintain vegetation. Some asbestos wastes are highly alkaline and may be very high in magnesium. The New Hampshire and Pennsylvania sites have had pHs of 12 or more. Too little soil on top of the asbestos wastes could result in vegetation being unable to become established or dying after several seasons of growth. In addition, asbestos tailings are lacking in nutrients. If a lesser depth of soil is used for a cap, the maintenance requirements should require frequent fertilization and pH adjustment to maintain a healthy mat of vegetation.

Vegetation is recommended to stabilize the cover when adequate rainfall is available to maintain growth without irrigation. The Corps of Engineers and the Soil Conservation Service have been very helpful in selecting vegetation types, mostly grasses and ground covers such as crown vetch, that are adapted to specific climate regions and particular soil types. In areas with little natural rainfall or on steep slopes a gravel or rip rap finishing layer should be used in place of vegetation. Asphalt or concrete paving is another option for a cap, especially on sites which may be designated for industrial uses, parking lots or driveways.

SITE CONSTRUCTION WORK

Some general recommendations have been made to guide responsible parties in the drafting of health and safety plans. OSHA-approved respirators should be required. Work clothing need not be impermeable but should be disposable or able to be cleaned on site. Under no circumstances should workers take contaminated clothing off the site for cleaning. A number of epidemiology studies have suggested that contaminated clothing can be a significant source of exposure to families of asbestos workers.

Visible emissions are a violation of NESHAPS. They also e danger site personnel and contribute to off-site air transport. Sp cial consideration must be given to dust control with water anc dust suppressant. If the asbestos is in large tailings piles, as it h been at several sites, the interior of the piles may or may not hav moisture content sufficient to prevent entrainment under lig wind conditions during removal activities. A moisture content 10% in addition to constant soaking during excavation to preve moisture losses through evaporation is recommended in these situ tions.

Buildings on or adjacent to the site should be sealed to preve dust infiltration. Air circulating equipment should be shut dow and intake vents should be covered with sheets of plastic. Door windows and foundation and roof vents should be sealed with pla tic, too. After the site work has been completed, buildings shou be hosed off. Equipment used on the site should be cleaned pri to installation of clean cover material. Equipment air filters shou be replaced prior to use on any other site.

MAINTENANCE PROVISIONS

Selection of cap design for either a burial pit or an above groun landfill should take into consideration the intensity of maintenan requirements and the presence of some private party, company governmental entity to continue oversight, maintenance and repa of the cap. The less likely a party is to be able to continue intensi maintenance, the more important the depth of the cap and th choice of vegetation or finishing layer of rocks becomes. Conser decrees or orders should contain specific requirements for mair taining the integrity of the cap through regular fertilization, pl adjustment, mowing, reseeding of vegetation and regular check and repairs of erosion damage or subsidence.

FUTURE USE OF PROPERTY

Deeds or property records should be noticed with the location size and depth of buried asbestos wastes. Property where asbesto has been buried on-site can be used in ways limited only in so far a a cap or burial pit cover should not be disturbed. If it is necessar to disturb the cap, care should be taken to rebury asbestos-con taminated soil securely; strict health and safety procedures shoul be observed during additional construction. U.S. EPA consent de crees have included requirements for a deed notice and advanc notification and prior approval of federal and state agencies fo any activity which would disturb the cap over an asbestos wast disposal site.

CONCLUSIONS

An asbestos waste disposal site shares many considerations anc features of its investigation, remedial design and remedial imple mentation with other hazardous waste sites. However, there are a number of important differences. Asbestos is not a regulated haz ardous waste under RCRA Subtitle C but is a regulated hazardou air pollutant under the Clean Air Act. Asbestos is, however, a haz ardous substance under CERCLA.

The primary endangerment from asbestos results from air trans port and inhalation exposure. There is little evidence that asbesto moves downward or laterally in subsurface soils. The primary re medial response for asbestos is burial. There are three major means of accomplishing this response: (1) excavation, transport and off site disposal; (2) excavation and on-site disposal; and (3) capping in place. A number of considerations are discussed in this paper for selection of remedies which are appropriate whether the govern ment or a private party will perform the remedial construction.

ACKNOWLEDGEMENT

The author thanks the following for the work involved at these sites:

- U.S. A.C.E. Cold Region Research Laboratory, Hanover, NH
- U.S. A.C.E. Arizona-Nevada Area Office, Phoenix, AZ
- Jerelean Johnson, U.S. EPA Region 9
- Paul Groulx, U.S. EPA Region 1
- Paul Hefernan, U.S. EPA Region 1

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4. "Asbestos Waste Management Guidance," U.S. EPA Publication #530-SW-85-007, Washington, DC, May 1985.
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United States
Environmental Protection
Agency

Office of Water and
Waste Management
Washington DC 20460

SW-867
September 1980

EPA

Evaluating Cover Systems for Solid and Hazardous Waste

R. KARL
Adopted 3/21/86
mean frost
depth
U.S.

avg. annual max. depth of freezi

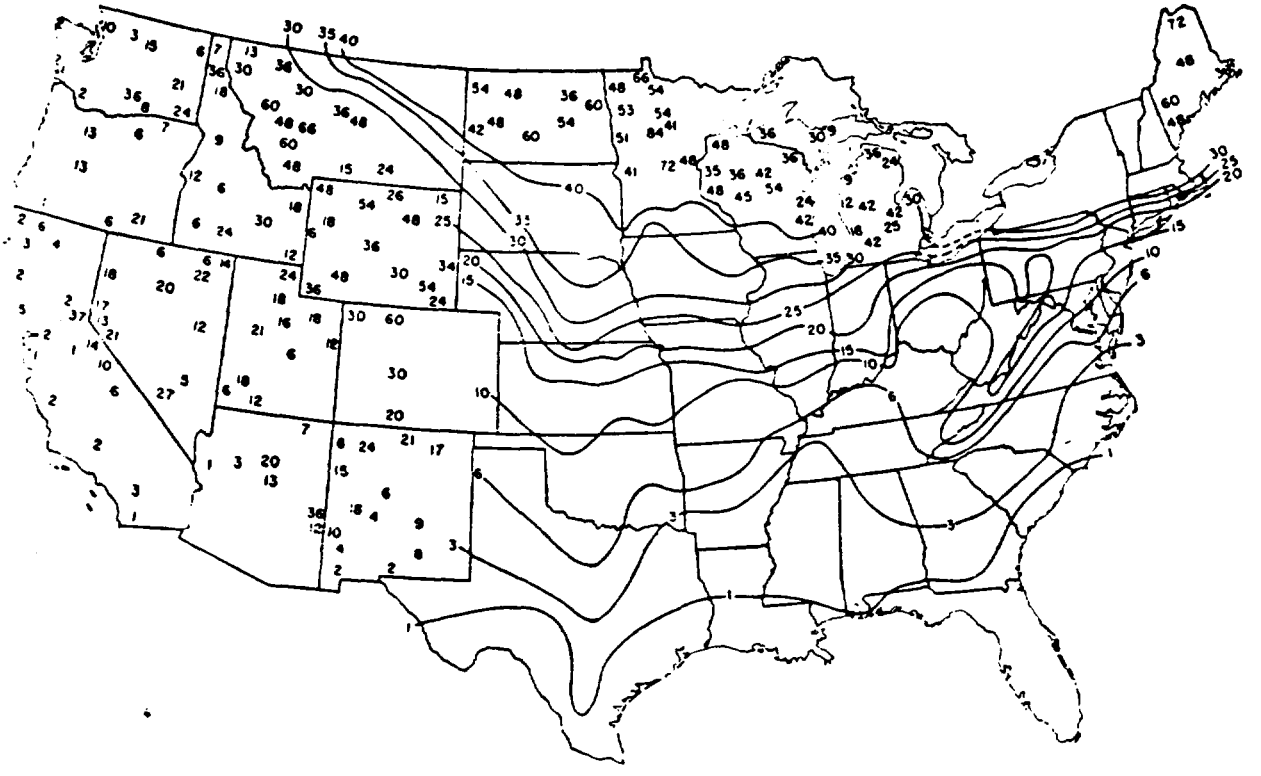

Figure 12. Regional depth of frost penetration in inches.[11]

principally increasing strength and reducing permeability. Figures 13 and 14 illustrate these effects and provide the evaluator some guidance on what can be achieved. The laboratory compaction test provides a useful data base on which the evaluator can judge the effects of compaction of the cover under consideration. It has been found[1] that soil compacted routinely over soft waste (municipal wastes) falls below standard compaction curves such as obtained in ASTM D698 (Table 1). The differences in field compaction results over spongy solid waste versus those over a hard base can be compensated approximately by using laboratory test procedures with fewer than the "standard" 25 blows of the compacting hammer. Keep in mind that the objective of the laboratory tests is to model actual field compaction of cover soil with dozers and other compacting equipment.

Approximate general guidance (Figure 15) has been derived regarding the field compaction effort necessary in 6 to 12 inches of soil cover on municipal solid waste. Field dry density of the cover can be predicted from measured placement water contents by using laboratory compaction curves at appropriately light compaction effort. For example, where a dozer makes four passes on the average, a 5-blow compaction curve should be determined

ENVIRONMENTAL PROTECTION AGENCY
REGION I
JFK FEDERAL BUILDING
BOSTON, MA 02203

TELECOPIER REQUEST

TO Brad Bradley
OFFICE U.S. EPA Region II PHONE # FTS 886-4742
TELECOPIER # 886-9096 CONFIRMING #

FROM Philip Boxell
OFFICE U.S. EPA Region I PHONE # FTS 223-0400

NUMBER OF PAGES TO FOLLOW 12

Date Sent
Time
By
Confirmed ___Yes ___No

PANAFAX MV 3000
FTS: 223-2531 (auto)
Comm: (617) 223-2531

DEX 4100
FTS: 223-5880 (manual)
Comm: (617) 223-5880

VERIFICATION:
FTS: 223-7212
Comm: (617) 223-7212

When sent & verified, return to

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APPENDIX A

DEPARTMENT OF THE ARMY
COLD REGIONS RESEARCH AND ENGINEERING LABORATORY, CORPS OF ENGINEERS
HANOVER, NEW HAMPSHIRE 03755

16 January 1984

Mr. Paul Groulx
U.S. Environmental Protection Agency
Region I
60 Westview Street
Lexington, MA 02173

Dear Paul:

Here are the design specifications for covering steep slopes on the waste asbestos deposits in Hudson, NH.

Also, the detailed calculations on the amount of material required to cover the deposit on the Coolidge/Tour of Hudson site.

I am also enclosing a memo documenting Alex Eskandari and my site visit with you last November; a management scheme for the grass cover on these sites; and a detailed

DISPOSITION FORM

For use of this form, see AR 340-15; the proponent agency is TAGO.

REPLACES OFFICE SYMBOL	SUBJECT
CRREL-EA	Inspection Visit of Waste Asbestos Sites in Hudson, NH (EPA Superfund Restoration)

TO	FROM	DATE	CMT 1
MFR	Richard McGaw	3 January 1984	

1. Reference letter of 26 October 1983 from EPA-Region I (Request for Assistance) and my Telephone Conversation Records of 26 October 1983 and 19 December 1983.

2. On 8 November 1983 Alex Iskandar and I traveled to Hudson, NH, and met Mr. Paul Groulx (EPA-Region I, Boston) and Mr. Mark Hall (Roy Weston, Inc - Spill Prevention and Emergency Response Division) for the purpose of inspecting an asbestos waste disposal site on the Coolidge property. We also viewed the restoration work accomplishe last summer by the EPA to cover eight former disposal sites in Hudson and Nashua, NH, according to specifications recommended by us.

3. The new site (Coolidge/Town of Hudson) is an asbestos deposit about 1/4 acre in area and about 20 ft in depth. It apparently was placed some 30 years ago and has been compacted by natural settlement. Small trees and shrubs have taken root on the steep north-, east-, and south- facing slopes. The upper surface, which slopes gently to the east, has recently been smoothed somewhat and grass has been planted by Mrs. Coolidge to provide a private recreational area. The owner clearly did not recognize the potential health hazard in disturbing this material.

4. Because portions of the Coolidge site are much steeper than any we have previously considered, adjustments to our former recommendations for covering the asbestos were discussed with Mr. Groulx at the site. We also visited a nearby sand and gravel pit to determine what sort of covering materials were available locally.

5. Recommendations for covering the Coolidge/Town of Hudson waste asbestos site will b given in a separate letter to EPA-Region I.

6. With Mr. Groulx we also inspected the two Virginia Road sites; the Alukonis, Bursey, Baker, and Matarazzo sites; the Coulomb and Pointer sites; and the Sprague site Nashua, NH, across the Merrimack River. Except for the Virginia Road sites, all of these waste asbestos deposits had been covered by the EPA during the period July-October 1983 under the emergency response provisions.

7. The Virginia Road sites had been covered in the fall of 1982 by Johns-Manville using 15 in. of soil cover and had been planted with grass. A chain link fence erected along one side of Virginia Road restricted access by children to the largest portion of the deposit. When we saw these sites they appeared to be in stable condition. We were told that some minor erosional repair had been required following the previous winter. Otherwise, the surface grading seemed to have been done well, an the grass was in good condition. The restoration work had clearly enhanced both the appearance and the health safety of the neighborhood.

8. The Virginia Road sites should be inspected yearly to determine whether asbestos particles are being brought to the surface through frost action, inasmuch as 15 in. is less than the recommended permanent cover. The long-term adequacy of the restoration will depend on the effectiveness of the underdrains which were installed at the time of the restoration.

CRREL-EA 3 January 1984
SUBJECT: Inspection Visit of Waste Asbestos Sites in Hudson, NH
(EPA Superfund Restoration)

9. The restoration work on the other disposal sites had been done by the EPA last summer. The Sprague site (Nashua) needed some reseeding where the grass seed had been washed away before it could germinate; however, there seemed to be no adverse erosion at the site. Also, the Matarazzo site required some slight corrective work at the rock apron leading down the steepest slope to the brook. With these exceptions, the covering of the waste asbestos had been done in an exemplary fashion, and much of the grass had developed some growth prior to the end of the growing season.

10. In the spring the distribution of grass growth should be monitored closely, so that reseeding can be done early in those areas showing less than adequate coverage with grass. Alex Iskandar has also pointed out that mowing should be done two or three times each growing season to stimulate growth.

R. McGaw

RICHARD W. MCGAW
Research Civil Engineer
Applied Research Branch

cf: Dr. I. Iskandar
Chief, P&P (One-stop service)
Chief, ESB

Management of Asbestos Disposal Sites After the First Year of Soil Cover

1. In mid-April 84, inspect the germination of the grass seed visually.
2. Spot reseed the area where seeds did not germinate (no color change observed).
3. Soil samples should be taken and tested for N, P and K, and recommendations on fertilizer application should be followed. At minimum, if no tests are done or will be done, 40 pounds of N fertilizer should be applied per 1,000 sq ft.
4. If hydroseeder will be used to reseed a large area, a 100-150 lbs of solids per 100 gallons of water is the maximum mixture. Solids include fertilizer, seeds and mulch materials.
5. Grasses to be used are Perennial Ryegrass, Tall Fescue, Kentucky Bluegrass, Reed Canarygrass or Birdfoot Trefoil. The following are the recommended combinations and amounts of each:

a. Switchgrass		5 (PLS)*
Bluestem (big or little)		5 (PLS)*
Perennial ryegrass		5
Birdfoot trefoil**		5
	Total	20 lb/AC
b. Tall fescue		20
Flat pea		30
	Total	50 lb/AC
c. Deer tongue		10 (PLS)*
Birdfoot trefoil		8
Perennial ryegrass		3
	Total	21 lb/AC
d. Deer tongue		10
Crownvetch**		15
Perennial ryegrass		3
	Total	28 lb/AC

* PLS pure live seed = $\frac{\%\ \text{germination} \times \%\ \text{purity}}{100}$

Actual lbs of commercial seed to be used = $\frac{100 \times \text{lbs of } 100\%\ \text{PLS}}{\%\ \text{PLS of commercial seed lot}}$

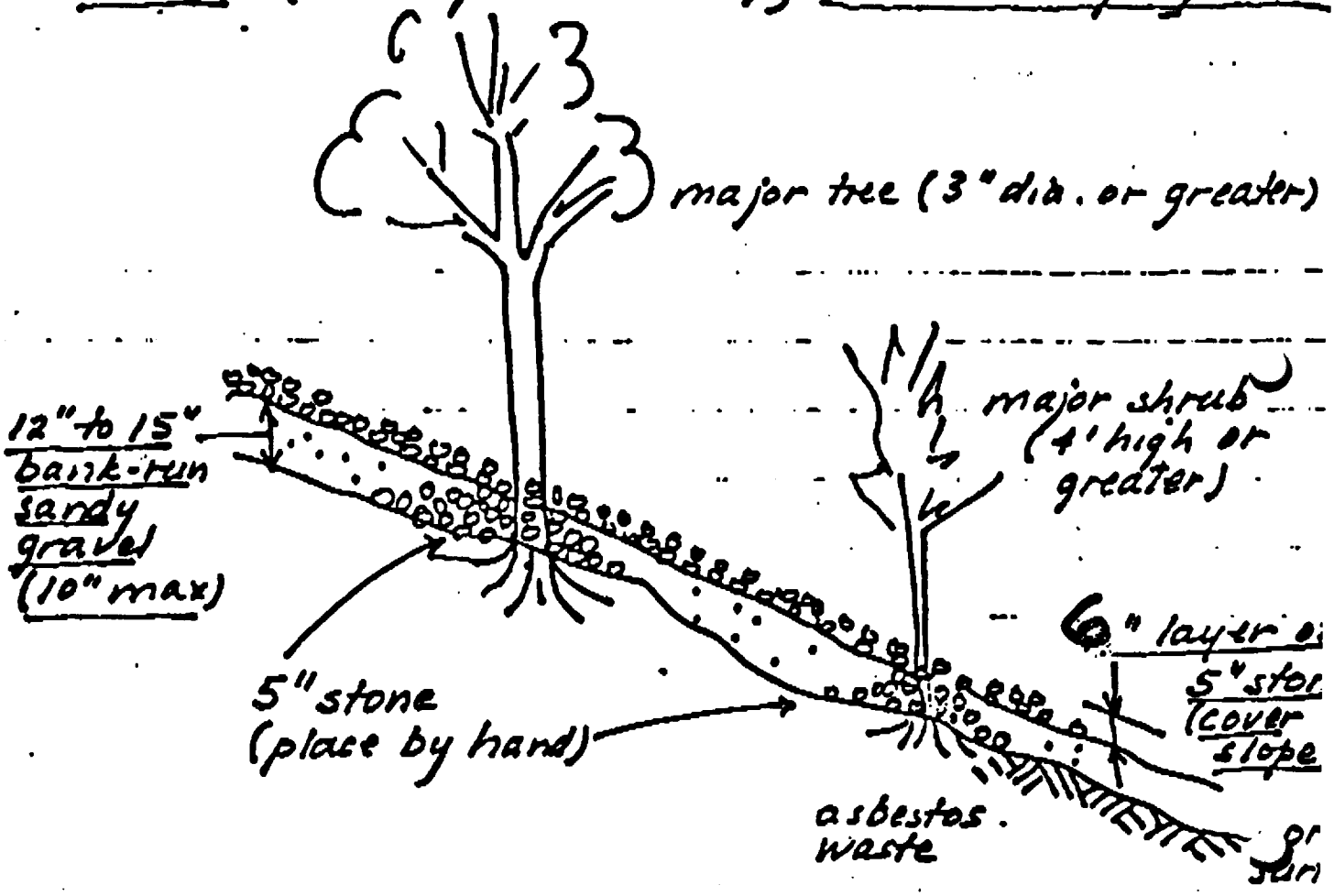
** Inoculate legume seeds; use four times the recommended amounts when hydroseeding.

6. Recommended Variety

Tall fescue (Kentucky 31)
Birdsfoot trefoil (Empire)
Switchgrass (Blackwell)
Perennial ryegrass (Norlea, Manhattan)

January 1984
T. Takaddar

SLOPES (new specification); with Existing Vegetation



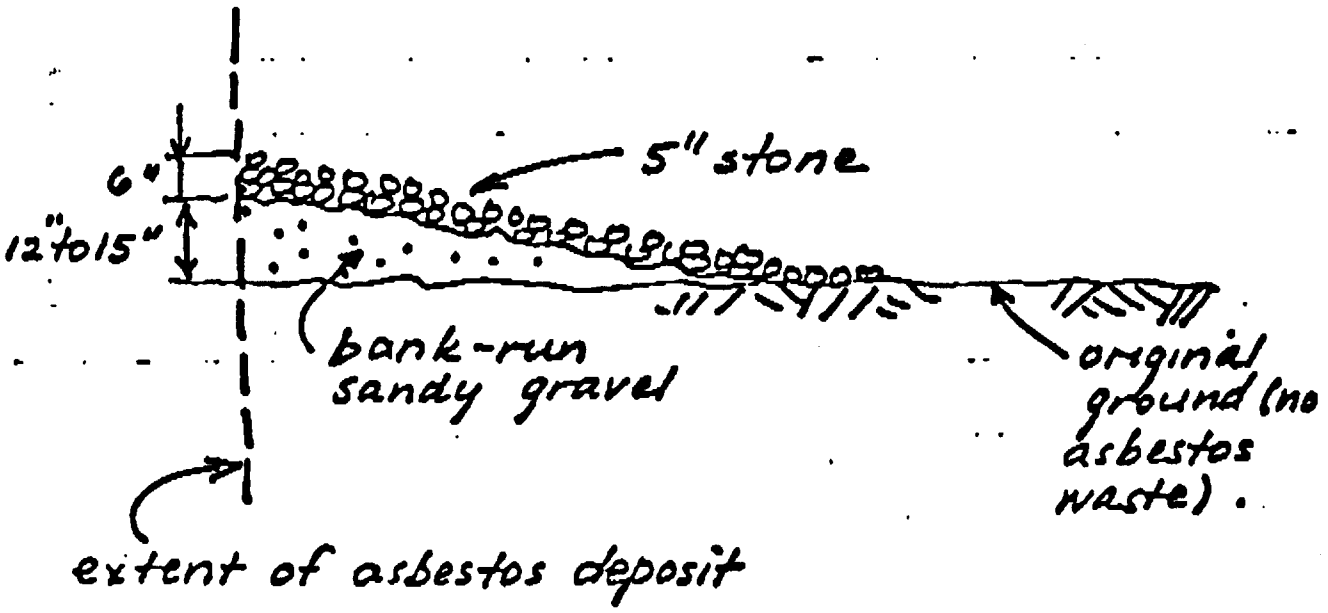
1) Retain and protect existing vegetation (trees, shrubs, saplings, etc.).

2) Place 5" stone around major trees and shrubs (to 12" depth near trunk) to provide aeration of root zone; most of stone will be upslope of trunk. Place to a diameter about equal to ½ the extent of the crown.

Rev 1/12/82

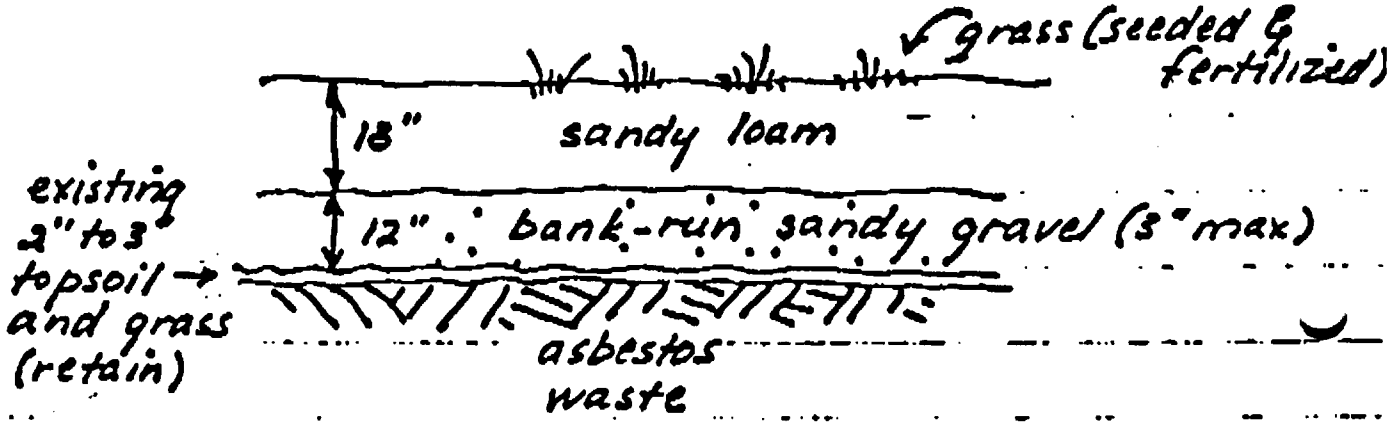
EDGE AREA (new specification):

Adjacent to Slope areas with existing vegeta



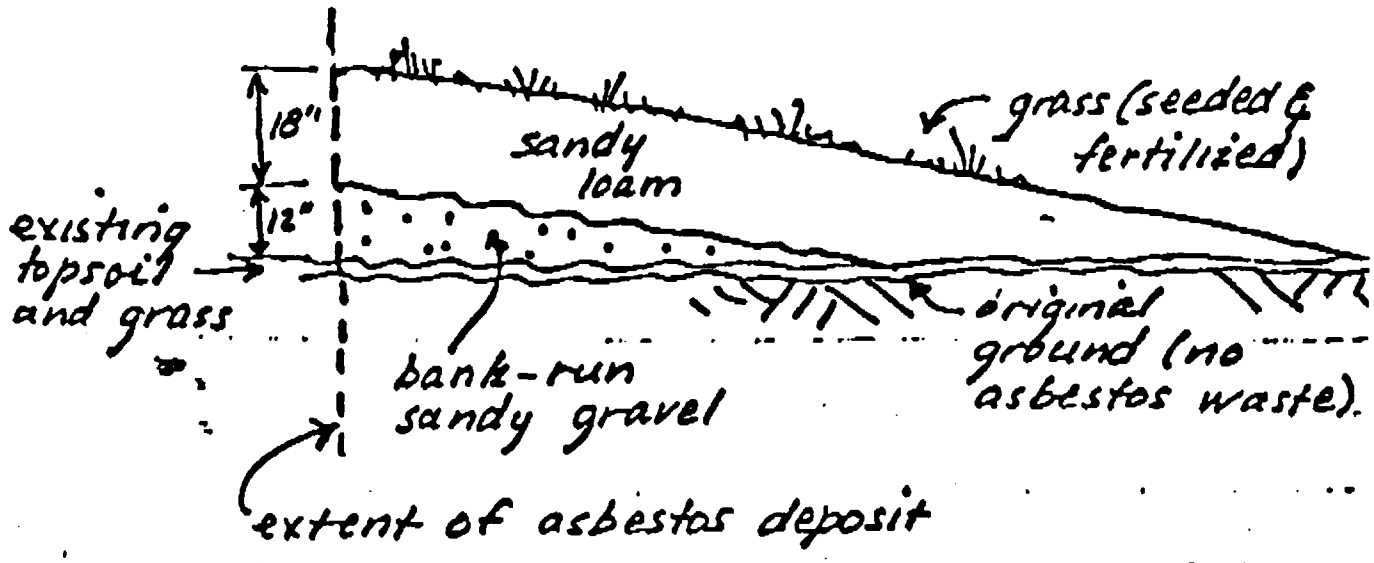
1/12/6

PLATEAU AREA (standard specification):

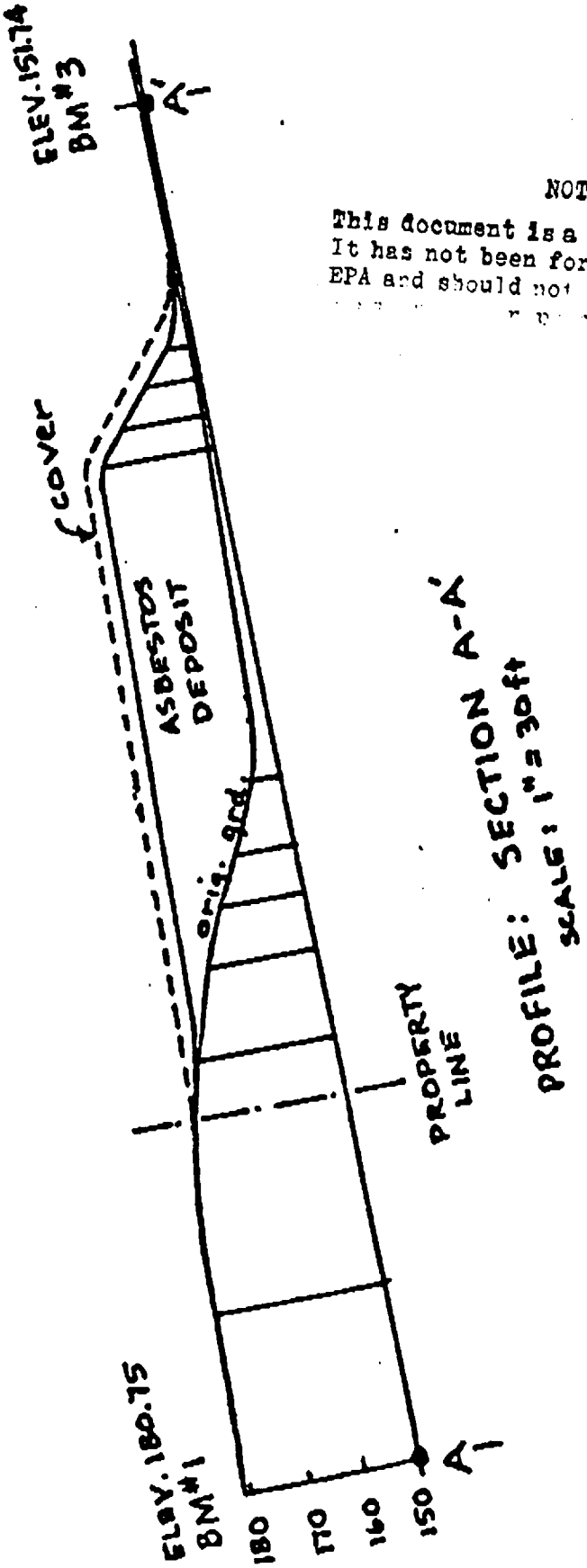


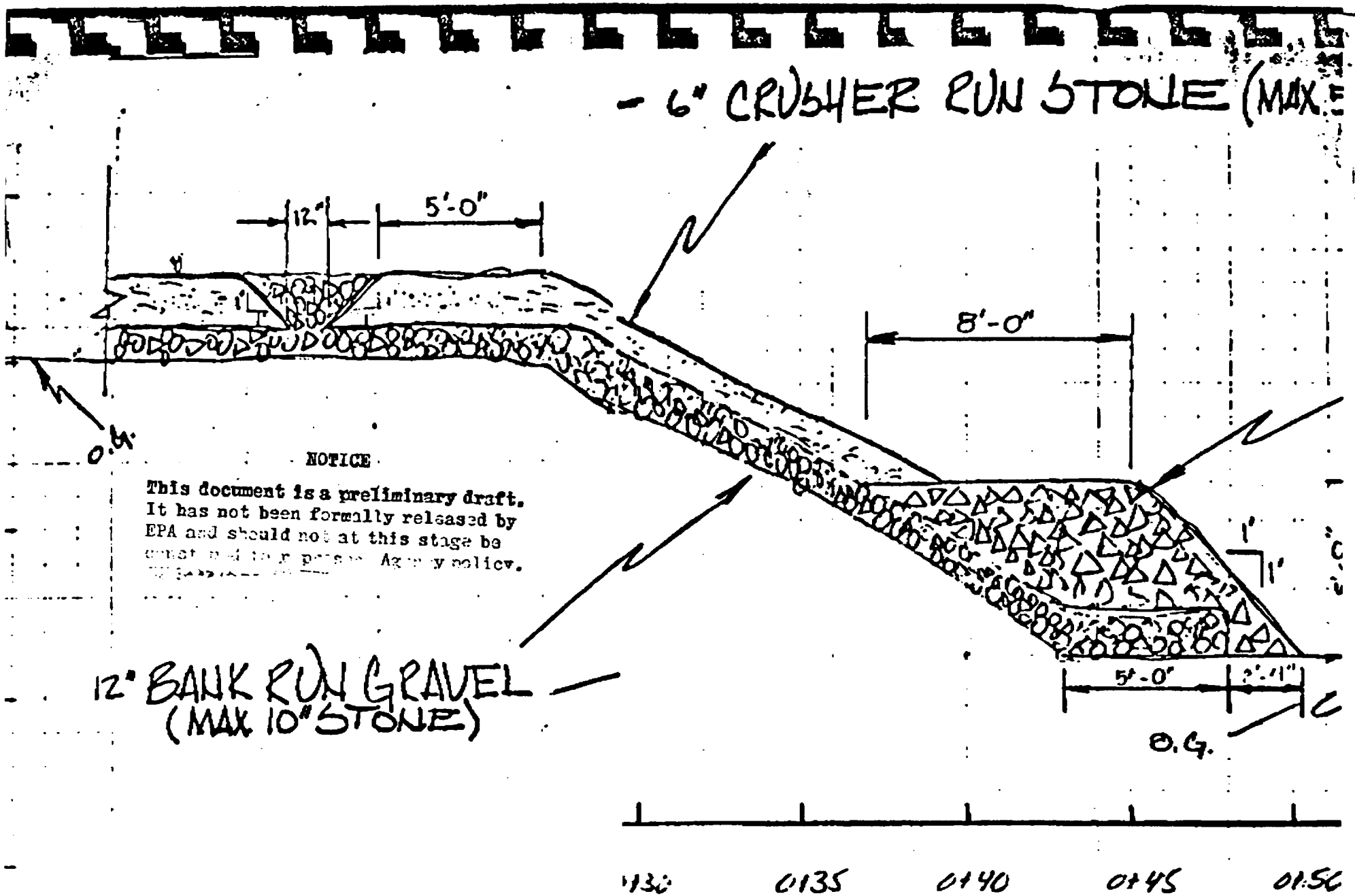
EDGE AREA (standard specification):

Adjacent to Plateau (flat) areas:



DEPARTMENT OF THE ARMY
COLD REGIONS RESEARCH AND ENGINEERING LABORATORY, CORPS OF ENGINEERS
HANOVER, NEW HAMPSHIRE 03755





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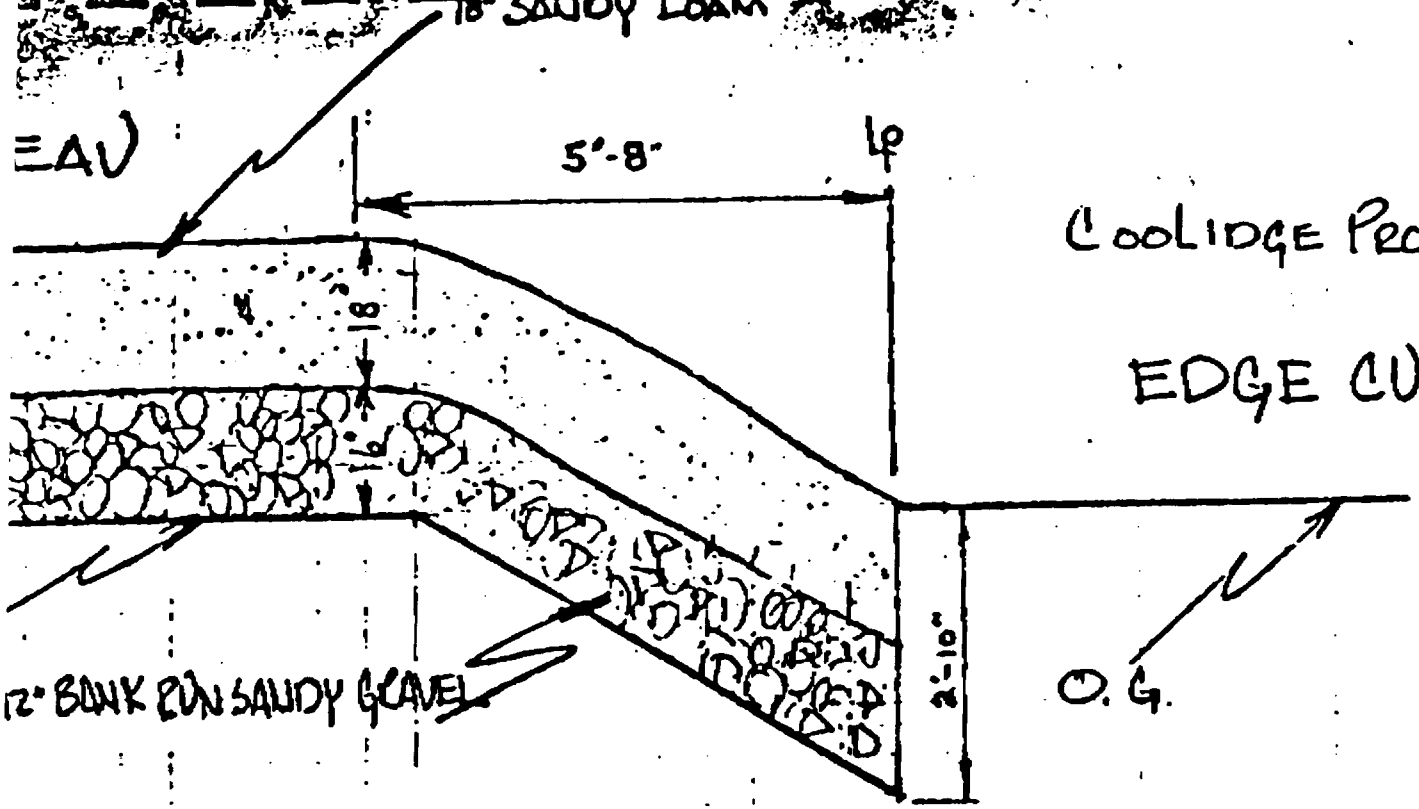
A-A



DETAIL B'-B'

SCALE 1" = 2'

Revision

TELEPHONE OR VERBAL CONVERSATION RECORD

For use of this form, see AR 340-15; the proponent agency is The Adjutant General's Office.

DATE: 2 June 1983

SUBJECT OF CONVERSATION: Reclaiming of asbestos waste sites in NH

INCOMING CALL		
PERSON CALLING	ADDRESS	PHONE NUMBER AND EXTENSION
PERSON CALLED	OFFICE	PHONE NUMBER AND EXTENSION

OUTGOING CALL		
PERSON CALLING: R. McGaw, A. Iskandar, D. Gaskin	OFFICE	PHONE NUMBER AND EXTENSION
PERSON CALLED: Carl Eidam	ADDRESS: EPA Office, Lexington, MA	PHONE NUMBER AND EXTENSION: FTS 223-7265, 617-861-6700

SUMMARY OF CONVERSATION:

1. A conference call was made to discuss what the required minimum cover on the asbestos waste sites at Hudson, NH, and at Nashua, NH, should be.

2. Iskandar and Gaskin were convinced that 12 inches of topsoil is necessary for long-term survival of grass cover.

3. McGaw recommended a minimum of 18 inches of sandy gravel beneath the topsoil, to limit frost depth and if possible to contain the frost front within the cover materials.

4. Overall minimum cover is therefore 30 inches (2.5 ft) in frost-prone areas. Cr will incorporate this into the final funding request.

5. We were told that our expertise was greatly appreciated, and was instrumental in protecting the public welfare in these cases. It is likely (we were told) that our help will save many dollars and will result in a much more successful solution to the toxic hazard situation.

6. When work begins on the sites we will be contacted again.

R. McGaw

This
It ha
EPA a

DEPARTMENT OF THE ARMY
COLD REGIONS RESEARCH AND ENGINEERING LABORATORY, CORPS OF ENGINEERS
HANOVER, NEW HAMPSHIRE 03755

April 2, 1984

NOTICE

This document is a preliminary draft. It has not been formally released by EPA and should not at this stage be construed to represent Agency policy.

Paul R. Groulx
On-Scene Coordinator
U.S. EPA, Region 1
60 Westview Street
Lexington, Massachusetts 02173

Dear Paul:

Here are the two memoranda I mentioned, in which the 30-inch standard depth for frost protection of asbestos waste against freezing was first set out.

Notice that between June 1983 and September 1983 Alex Iskandar had found that not 12 inches but 18 inches of topsoil was adviable.

Sincerely,

Dick

Richard W. McGaw, P.E.
Research Civil Engineer
Applied Research Branch

Enclosure

NOTICE

It has not been formally released by EPA ... McGaw

DISPOSITION FORM

For use of this form, see AR 340-15, the proponent agency is TAGO.

REFERENCE OR OFFICE SYMBOL	SUBJECT
CRREL-EA	Reclaiming of Asbestos - Waste Sites in Hudson, NH (EPA Superfund Restoration).

TO	FROM	DATE	CMT 1
MFR	D. McGaw	13 Sep 83 MCGAW/mh	

1. References: My Telephone Conversation Records of 27 May 83, 2 June 83, and 31 Aug 83, on same subject.

2. On 25 and 26 Aug 83, Dr. I. Iskandar and I traveled to Concord, NH, to give expert testimony for the U.S. Environmental Protection Agency (EPA) in Federal District Court, upon the request of Sheila Jones (Attorney for Dept. of Justice, Wash., DC) and Philip Boxell (Attorney for EPA Regional Office, Boston, MA).

3. The case involved a request by the United States for a Temporary Injunction under the Superfund regulations to gain access to six Johns-Manville asbestos-disposal sites in order to provide emergency cover of soil and grass. Two property owners (A. Mantarazzo and J. Bursey) were denying the U.S. access to the sites on the grounds that they not be held financially liable for the restoration (burial) of the toxic material.

4. Paul Heffernon (EPA) testified on the physical characteristics of the disposal sites.

5. Dr. Robert Sawyer, M.D., testified on the medical hazards of the asbestos waste (scraps, pellets, and fibers).

6. I testified on the depth of cover required to keep the asbestos material from being returned to the surface through the yearly process of freezing and thawing. The principle is simple: to keep the frost front from entering the hazardous layer by providing a depth of moist soil equal to the probable depth of freezing in that location. Using standard Corps of Engineers design procedures based on freezing indices, I calculated that the maximum depth of frost would be about 36 in. at Hudson, NH (fairly near the coast) for possibly one year in ten. I recommended an expedient depth of cover of 30 in. of sandy gravel or its equivalent as being sufficient to provide 50 to 100 years of protection.

7. Alex Iskandar testified on the depth of organic topsoil needed to sustain a permanent grass cover over the asbestos material, which is very alkaline (pH of 11 or 12). He recommended at least 18 in. of topsoil, because it had been determined that the roots will extend to that depth. The remaining 12 in. of cover would be a sandy gravel, coarse enough to be of low frost-susceptibility and fine enough to contain sufficient moisture to support the vegetation at the surface.

8. The decision of the court is attached. As Mr. Boxell states, the decision granted the U.S. everything the attorneys were asking for.

R. McGaw

RICHARD W. MCGAW
Research Civil Engineer
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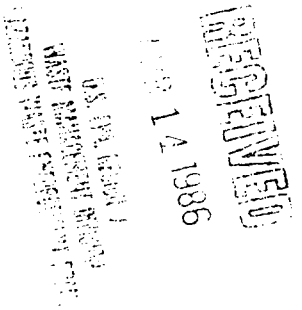
Refer to: L109719014 -- Lake County
Waukegan -- Johns-Manville
Superfund -- Gen. Correspondence



April 9, 1986

Rodney Gurther 5HR11
USEPA - Region V
230 South Dearborn
Chicago, Illinois 60604

Dear Rodney:

The following details may help you in the development of your letter to Johns-Manville and KMA.

Note, all of the following sections were taken from the Illinois Pollution Control Board, Environmental Protection Act, Title 35 - Subtitle G, Chapter I, subchapter i, Part 807.

1. Subpart A, Section 807.104 (p. 213) definition of "waste".

2. Subpart E, Section 807.501(a) (p. 218) closure plan refers you to Subpart C.

3. Subpart C, Section 807.305(c) (p. 216) final cover.

4. Waste Management Facilities Design Criteria for a Class II Landfill Site (non-hazardous) IV cover material D1 & 2 (p. 12).

The IEPA would expect you to place in your letter that Johns-Manville would be expected to file a closure-post-closure plan as stated in Subpart E, Section 807.503.

I hope this helps you out.

Sincerely,

Jeff Larson
Project Manager, FSMU
Division of Land Pollution Control

JL:ct/809F,16

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